The good, the bad, and the gross

Wagemans, Fieke

Publication date:
2018

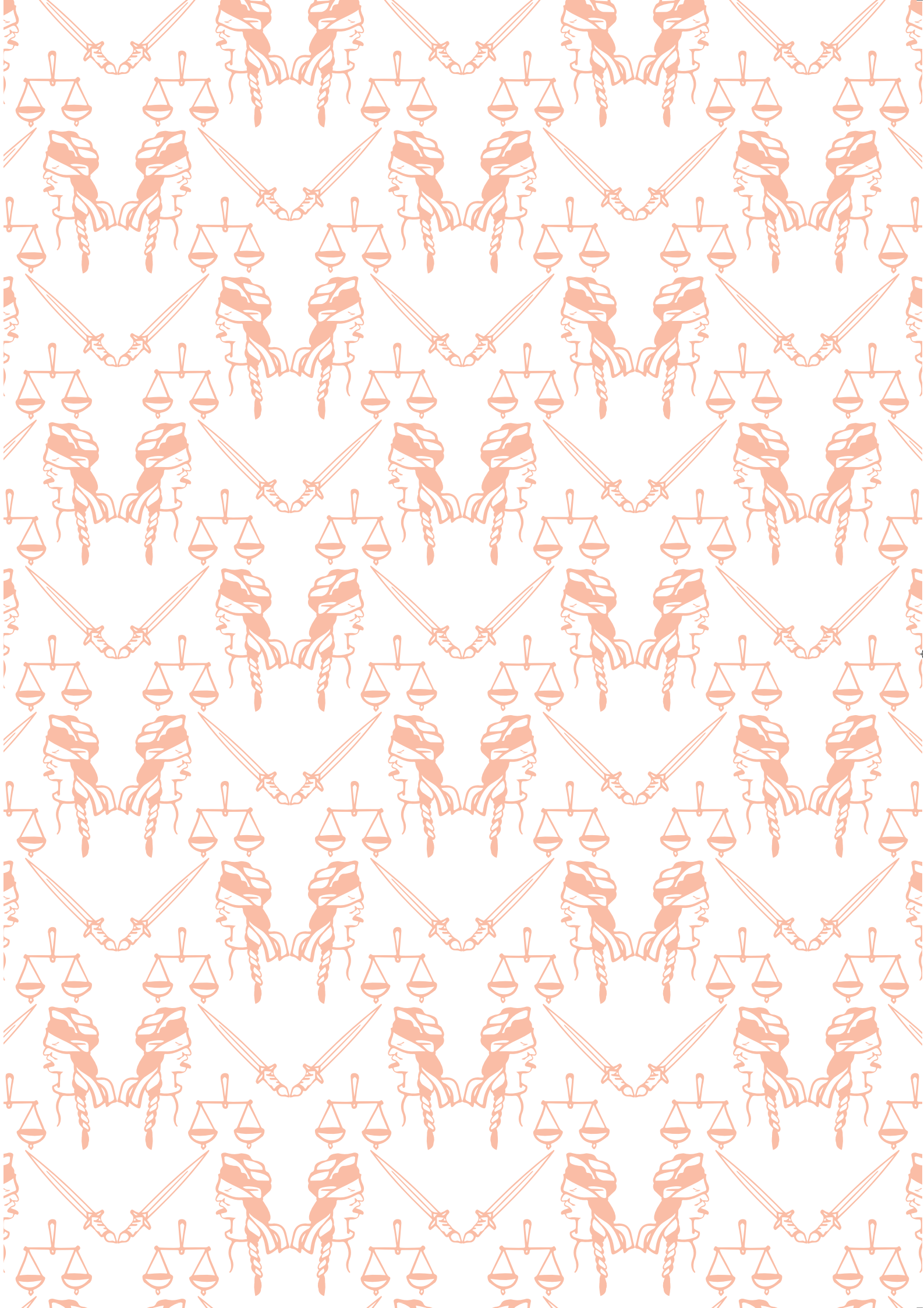
Document Version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Wagemans, F. (2018). *The good, the bad, and the gross: Disgust sensitivity and moral judgments*. Proefschriftmaken.

THE GOOD, THE BAD, AND THE GROSS

Disgust sensitivity and moral judgments

Fieke M. A. Wagemans



The Good, the Bad, and the Gross

Disgust Sensitivity and Moral Judgments

Fieke M. A. Wagemans

Geprint door: ProefschriftMaken || www.proefschriftmaken.nl
Ontwerp omslag: Floor Weijs || www.floorweijs.nl

The Good, the Bad, and the Gross

Disgust Sensitivity and Moral Judgments

PROEFSCHRIFT
ter verkrijging van de graad van doctor aan Tilburg University
op gezag van de rector magnificus,
prof. dr. E.H.L. Aarts,

in het openbaar te verdedigen
ten overstaan van een door het college
voor promoties aangewezen commissie
in de aula van de Universiteit
op vrijdag 8 juni 2018 om 14.00 uur

door Fieke Maria Antoinet Wagemans,
geboren te Venray.

Promotor	prof. dr. Marcel Zeelenberg
Copromotor	dr. Mark J. Brandt
Promotiecommissie	dr. Yoel Inbar
	dr. Susann Fiedler
	prof. dr. Lieven Brebels
	dr. Joshua M. Tybur
	dr. Lotte F. van Dillen

Contents

1

Introduction

Chapter 1

Throughout evolutionary history, a recurring challenge for humans has been to avoid potentially fatal pathogens. It has been theorized that disgust evolved to alert us to the presence of such pathogens. However, people also express feelings of disgust in the absence of a direct pathogen threat. A quick search of Twitter reveals that disgust is commonly used while referring to people or acts that are perceived to be immoral. Harassment, pedophilia, immigrants, an unfair tax bill, liberals, conservatives, abortion, cheating on your partner, disrespecting one's nation, bullying, white privilege, stealing, and not in the least, Donald Trump. The list of morality-related topics that are perceived as disgusting is long.

The notion that our sense of morality is associated with feelings of disgust (among other emotions) also finds support in the moral psychology literature. Numerous empirical studies demonstrate that moral transgressions and moral transgressors cause feelings of disgust (e.g., Haidt, McCauley, & Rozin, 1994; Rozin, Lowery, Imada, & Haidt, 1999). Researchers have also investigated whether the relationship between morality and disgust can work in the opposite direction: Can disgust influence moral judgments? (e.g., Eskine, Kacinik, & Prinz, 2011; Schnall, Haidt, Clore, & Jordan, 2008; Wheatley & Haidt, 2005). In the last two decades, a lot of attention has been devoted to answering this question, but with mixed results (see Landy & Goodwin, 2015). While inducing disgust does not seem to cause harsher moral condemnation (also see the section "Disgust as an amplifier of moral judgments", p. 10), individual differences in disgust sensitivity (i.e., trait disgust) show more reliable associations with moral decision-making. More specifically, it seems that individuals high in disgust sensitivity tend to be harsher moral judges (e.g., Crawford, Inbar, & Maloney, 2014; Inbar, Pizarro, & Bloom, 2009; Terrizzi, Shook, & Ventis, 2010). While this relationship is well-established, some questions about the nature of this relationship still need to be answered. The first aim of this dissertation is therefore to investigate when and why disgust sensitivity affects moral judgments. In my quest to explain this relationship, it also becomes clear that the

key to a better understanding might lie in improving our comprehension of disgust sensitivity. The second aim of this dissertation is therefore to provide more insight into what it means to be more or less disgust sensitive.

Moral Decision-Making

How people make moral judgments has been, and still is, a topic of much debate in moral philosophy and psychology. Much of this literature starts by pitting rational versus emotional routes to moral judgment against each other. While some think about moral judgments as the result of rational and controlled analysis, others argue that they are derived from a highly emotional and intuitive process.

Reason-Based Morality

Moral rationalism is the idea that there are a priori moral truths that can only be understood through reasoning. Its roots can be traced back to ancient Greece: Plato (360 BC/2008) reasoned that knowledge of what is morally good can only be obtained when reason rules over passions (i.e., what we nowadays refer to as emotions and desires). The idea of moral rationalism was for long the dominating perspective on morality, although it appeared in slightly different forms over the years. For example, in the late 18th century, Kant (1797/1998) argued that the motive behind an action determines its moral worth. In this view of moral rationalism, only actions arising from principles discovered by reason, as opposed to emotions, can qualify as morally good.

What theories of moral rationalism have in common is that they disregard emotional input as useful information to the moral decision-making process. Emotions (or passions) are perceived as distractions and rational reflection is needed to control them. Only when reason can control one's passions, one can lead a moral life.

This perspective of emotions as disruptive to the moral decision-making process can still be found in our modern society. For example, in some professions (e.g., judges, doctors), people are required and trained to ignore their gut feeling or emotions when making moral decisions because we believe their decisions will be better when based on rational thinking.

Reason is Slave to the Passions

The dysfunctional role of emotions in morality was not agreed upon by everyone. Hume was one of the first to acknowledge the guiding role of emotions in moral decision-making, stating that "reason is, and ought only to be the slave of the passions" (1739-1740/1969, p. 462). According to him, reason is merely a means to find structure in our passions. Passions though, provide people with a moral compass and direct moral thinking and acting, something reason alone cannot do. In a time when religion, which associated passions directly with sins, was of utmost importance to many individuals, his perspective did not inspire much popular support. However, it was picked up again by modern psychologists. For example, Haidt (2001) built on the idea of moral sentimentalism with his social intuitionist model, suggesting that brief flashes of so-called moral intuitions inform us on the approval or disapproval we feel towards a given situation. Reason plays a very limited role in this perspective on moral judgment making, as it is only activated post hoc when justifications for one's moral intuition are needed. Evidence for this perspective is based on instances of moral dumbfounding, in which people instantly express strong moral convictions regarding an issue or behavior in the absence of rational arguments. In these cases, it appears that people's moral judgments have little to do with reflective reasoning, but are the direct result from an automatic and highly emotional process.

That moral decision-making is not a purely rational process also becomes clear from people's responses to the famous Trolley and Footbridge dilemmas (Thomson, 1976; Thomson, 1985). Although in

both thought experiments, one is faced with the dilemma of killing one innocent person to save five others, the circumstances are slightly different. In the Trolley Dilemma participants read a scenario in which a runaway trolley is approaching five people that are tied to the tracks. If nothing is done, these five people will be killed by the trolley. However, participants are told they can save the five people by pulling a lever, which will divert the trolley onto a sidetrack where one person is tied to the tracks. In the Footbridge Dilemma, the runaway trolley is again approaching five people that are tied up on the tracks. Participants are then told they are standing next to a large man on a footbridge above the tracks. They can save the five people by pushing the large man off the footbridge on the tracks, which will stop the trolley. In both cases, participants are thus faced with the dilemma of killing one person to save five.

The question is whether one finds it morally permissible to pull the lever/push the large man of the footbridge and thus prevent five deaths at the cost of one. If morality is purely based on a rational cost-benefit analysis, both actions should be deemed permissible. After all, five deaths are clearly worse than one. Yet, while most people think it is permissible to pull the lever in the trolley dilemma, only a small fraction of people feel the same way about pushing the large man off the footbridge (Thomson, 1976; Thomson, 1985). This shows that people do not always follow a rational, calculated approach when making moral judgments. Instead, it seems that many moral situations elicit emotional responses that drive our moral evaluation. For instance, neuroimaging studies have shown that personal moral transgressions, such as the footbridge dilemma, lead to stronger activation of emotion-related brain regions than impersonal moral transgressions, such as the trolley dilemma (see Greene, 2014 for an overview). Moreover, patients with emotion-related brain disorders make different moral decisions than healthy individuals, even though these patients have a good understanding of moral rules and norms (e.g., Ciaramelli, Muccioli, Làdavas, Di

Pelligrino, 2007; Mendez, Anderson, Shapira, 2005; also see Huebner, Dwyer, & Hauser, 2008).

While moral rationalism views emotions as dysfunctional to the moral decision-making process, this is not necessarily the case. Functional perspectives of emotions argue that each emotion serves a unique adaptive function (e.g., Zeelenberg & Pieters, 2006; also see Keltner & Gross, 1999). So-called moral emotions are thought to function as enforcers of social relationships and commitments (e.g., Fiske, 2002; Frank, 2001) and thereby also help uphold a society's norms. However, each moral emotion contributes in a unique way. For example, guilt might be felt after hurting someone else, motivating the transgressor to repair the relationship (i.e., by apologizing). Similarly, someone might express anger in response to someone cheating in a game of cards, thereby upholding the norm of fair play. Emotions can thus be very useful guides, signaling to oneself or others that moral standards have been violated. One of these emotions is disgust.

Disgust

The word *disgust* is a combination of the Latin words for 'opposite of' (i.e., "dis") and "to taste" (i.e., "gustare"), and thus essentially means "something offensive to the taste" (Darwin, 1872, p. 257). This reflects the idea that disgust is thought to have originated as part of a food-rejection system, defending against oral incorporation of potentially harmful foods by motivating avoidance and withdrawal from such foods (Rozin & Fallon, 1987). This is also expressed in the characteristic facial expression of disgust. Raising of the upper lip, sticking out of the tongue, a wrinkling of the nose, and narrowing of the eyes are all intended to reject the taste, smell, and sight of bad foods (Chapman, Kim, Susskind, & Anderson, 2009; Vrana, 1993). However, over time disgust evolved to serve a more general disease avoidance function (Curtis, Aunger, & Rabie, 2004; Curtis & Biran, 2001; Oaten, Stevenson, & Case, 2009), defending

the body against a wider range of pathogen threats. Bodily products, animals, sexual acts, or death are only a few examples of stimuli that trigger disgust because of their contamination potential (Curtis & Biran, 2001; Haidt, Rozin, McCauley, & Imada, 1997).

Disgust is not only relevant to contamination issues, but it is thought to be coopted by the moral domain. Although it is not yet clear what explains this exaptation, the rejection impulse and strong facial expression associated with disgust lend itself well for moral situations. Disgust motivates avoidance of norm violators, thereby not only preventing us from getting into contact with physical, but also social parasites (Curtis & Biran, 2001, Inbar & Pizarro, 2014; Tybur, Lieberman, & Griskevicius, 2009). Disgust also has a social signaling function: Expressing disgust in response to moral transgressions signals to others that their behavior is unacceptable (Kupfer & Giner-Sorolla, 2017; Tybur, Lieberman, Kurzban, & DeScioli, 2013). As such, feelings of disgust help uphold moral standards. It is thus not surprising that a vast body of literature demonstrates the importance of disgust in moral psychology.

Moral Transgressions Elicit Disgust

As mentioned in the first section of this chapter, people express feelings of disgust, alongside other emotions, in response to violations of moral norms. This notion also finds support in the literature. Studies using self-report measures find that people feel disgusted after reading about a wide variety of immoral acts, including, but not limited to, stealing, cheating, taboo behaviors, transgressions of sexual norms, and behaviors violating the purity of the body (e.g., Gutierrez & Giner-Sorolla, 2007; Haidt et al., 1994; Horberg, Oveis, Keltner, & Cohen, 2009; Hutcherson & Gross, 2011; Jones & Fitness, 2008; Molho, Tybur, Güler, Balliet, & Hofmann, 2017; Rozin, Lowery, & Ebert, 1994; Rozin, Lowery et al., 1999; Russell & Giner-Sorolla, 2013).

Some have questioned whether this so-called socio-moral disgust is equivalent to disgust experienced in response to pathogen

cues or whether it is more likely that disgust is used in a metaphorical sense (Royzman & Sabini, 2001; Simpson, Carter, Anthony, & Overton, 2006). Researchers have therefore directly compared core to socio-moral disgust. For example, neurological research shows that pathogen and socio-moral stimuli elicit activation in many common brain areas (Borg, Lieberman, & Kiehl, 2008; Moll et al., 2005). Similarly, Chapman and colleagues (2009) tested whether facial expressions in response to fairness violations are comparable to facial expressions elicited by disgusting drinks and disgusting pictures. They largely are. All three types of stimuli caused activation in the levator labii muscle region, causing the characteristic facial expression of disgust (i.e., a raised upper lip and wrinkled nose; also see Cannon, Schnall, & White, 2011).

In one of my own projects, I asked participants to list all attributes they think of when they think of disgust (i.e., explain the experience of disgust to someone who has no experience of disgust; Wagemans, Brandt, & Zeelenberg, in preparation). In line with the idea that disgust has a moral component, subjects mentioned attributes that can be categorized as moral disgust (i.e., someone being immoral, disapproval, breaking social norms) as well as attributes typically associated with core disgust (i.e., feeling sick, something unappealing, nausea). Although none of these studies provides conclusive evidence that socio-moral and core disgust are the exact same emotion, they do suggest that 1) there is a large overlap in (neuro)physiological responses to elicitors of these two subtypes of disgust and 2) people perceive the moral component as an intrinsic part of the emotion of disgust.

Disgust as an Amplifier of Moral Judgments

One proposition regarding disgust's role in moral decision-making is that feelings of disgust *cause* harsher moral judgments. This proposition builds on classical psychological principles, such as affect-as-information and misattribution of arousal (Dutton & Aron, 1974; Schwarz & Clore, 1983), in which people use their bodily reactions or

feelings as a basis when forming judgments. In the case of disgust, it is thought that people use feelings of disgust as an indication of their evaluation of the moral transgression at hand, resulting in a harsher moral judgment. Empirical support for this idea was first provided by Wheatley and Haidt (2005), who showed that brief flashes of disgust, induced by hypnotization, resulted in harsher moral judgments. It did not take long before other researchers reported similar effects using many different disgust manipulations, including disgusting pictures, videos, drinks, smells, sounds, and environments (e.g., Eskine et al., 2011; Harlé & Sanfey, 2009; Sato & Sugiura, 2014; Schnall, Benton, & Harvey, 2008; Schnall, Haidt et al., 2008; Seidel & Prinz, 2013; Ugazio, Lamm, & Singer, 2012; Van Dillen, Van der Wal, & Van den Bos, 2012).

While some of these studies investigated potential moderators, it was largely unclear what could account for the amplification effect. When I started my PhD project, the plan was therefore to determine the psychological mechanism(s) underlying this amplification effect of disgust on moral judgments. The only problem we (i.e., me and my supervisors) ran into was that our studies did not replicate the original effect of disgust on moral judgments. Although our disgust inductions in these studies were effective, they did not increase moral condemnation in any reliable or systematic manner.

Not long after our first series of studies, Landy and Goodwin (2015) published their meta-analysis on the amplification effect of incidental disgust on moral judgments. Their conclusion was that the evidence in favor of an amplification effect was scarce. After accounting for publication bias, there is no effect of disgust on moral judgments. In line with this conclusion, a highly-powered direct replication attempt failed to find that inducing disgust by means of a recall caused harsher moral judgments (Johnson et al., 2016).

While it was concluded from the meta-analysis that there was no overall effect of disgust on moral judgments after accounting for publication bias, it did show a small amplification effect for olfactory

and gustatory manipulations of disgust. However, this seems primarily due to a particularly large effect size found in one of the studies (i.e., Eskine et al., 2011). In this study, it was found that moral judgments were harsher after participants consumed a bitter (i.e., disgusting) drink as compared to consuming water or a sweet drink. As this original study was conducted with a small sample, several researchers, including myself, recently conducted a highly powered direct replication of this study, facilitated by the Collaborative Replications and Education Project (CREP). Although data analysis has not been conducted on the full sample, preliminary analyses show that no evidence is found for an amplification effect of disgust (Ghelfi et al., in preparation). Taking all these studies together, it therefore seems unlikely that individuals become harsher moral judges after inducing feelings of disgust that are completely unrelated to the moral judgment at hand.

Disgust Sensitivity

The evidence looks more promising for individual differences in disgust sensitivity. Disgust sensitivity, or trait disgust, is an individual's proneness to experience disgust intensely or easily in response to aversive stimuli (Haidt et al., 1994). Studies have shown that higher disgust sensitivity is related to opposition of, among other things, gay marriage, abortion, and premarital sex (Brenner & Inbar, 2014; Inbar, Pizarro, & Bloom, 2009; Smith, Oxley, Hibbing, Alford, & Hibbing, 2011; Terrizzi et al., 2010), and to support for stricter foreign and immigration policies (Brenner & Inbar, 2014; Terrizzi et al., 2010). Disgust sensitive individuals make harsher convictions in a fictitious murder trial (Jones & Fitness, 2008) and they tend to hold less favorable attitudes towards individuals that are thought of as deviant or of low status, such as homosexuals, the obese, poor people, immigrants, foreigners, and drug addicts (Crawford et al., 2014; Hodson & Costello, 2007; Inbar, Pizarro, Knobe, & Bloom, 2009; Olatunji, 2008; Terrizzi et al., 2010). Thus, a host of studies suggest

that highly disgust sensitive individuals uphold higher moral standards.

Although a lot of research has focused on the relationship between disgust sensitivity and moral cognition, the nature of this relationship is still unclear. For example, it is unclear whether disgust sensitive, as compared to less disgust sensitive, individuals are harsher moral judges in general or only when it concerns a specific type of moral transgressions. Little is also known about the psychological mechanisms underlying the relationship between disgust sensitivity and moral decision-making in general. Is the relationship driven by perceptions of harmfulness? Or are disgust sensitive individuals sensitive to any kind of deviation from what is normal (i.e., not only in the moral domain)? While investigating these questions, it became clear that there is also still a lot to learn about basic processes associated with disgust sensitivity itself. How do individuals low and high in disgust sensitivity react when confronted with disgusting stimuli? Do disgust sensitive individuals have a bias towards or away from such stimuli? And is this bias specific to disgusting stimuli or is it also triggered by stimuli associated with general negativity? In this dissertation, I aim to answer these, and related, questions.

The Structure of Morality

In the search for answers to these questions, I will draw from several perspectives on morality and moral psychology. The conclusions based on the empirical work presented in this dissertation will therefore not only address our initial research question, but will also speak to the broader debate on the structure of morality. This debate is centered around two distinct perspectives of morality: Moral monism and moral pluralism. What distinguishes these two types of perspectives is that they each offer their own take on what the building blocks of morality are. While advocates of moral monism

suggest that morality can be understood by a single, all-encompassing element, perspectives of moral pluralism argue that morality can be divided into multiple distinct elements.

Moral monism

Theories of moral monism argue that morality can be understood by one all-encompassing value. When faced with a moral decision, the objective is to choose the option that maximizes one's outcome on that value. With regard to the work presented in this dissertation, this view implies that moral judgments can be reduced to, and thus explained by, one overarching value. Over the years, several candidates for this value have been proposed. Examples are justice (Kohlberg, 1971), well-being (Harris, 2010), and fairness (Baumard, André, & Sperber, 2013). A monist theory that gained in popularity is the Theory of Dyadic Morality (Gray, Young, & Waytz, 2012). This theory states that all moral transgressions consist of a dyad, in which a moral agent harms a moral patient (Gray & Wegner, 2011). Perceptions of harm therefore underlie all morality according to this theory (Gray, Young et al., 2012).

Moral pluralism

Theories of moral pluralism, on the other hand, suggest that morality can be divided into anywhere between two and six elements (e.g., Gilligan & Wiggins, 1988; Graham, Haidt, & Nosek, 2009; Haidt, 2012; Janoff-Bulman & Sheikh, 2012; Shweder, Much, Mahapatra, & Park, 1997). In this dissertation, I will use the distinction proposed by Moral Foundations Theory (MFT), as it is the most widely used theory of moral pluralism. MFT aims to incorporate evolutionary and cultural perspectives on morality (Graham et al., 2013). It poses that each individual is born with the same template of "learning modules" for morality, but that cultural factors (e.g., upbringing or customs) determine to what extent these learning modules are exploited. MFT initially identified five of these learning modules, or moral domains: Care, fairness, authority, ingroup loyalty,

and purity. However, liberty has been suggested as a possible sixth candidate (Graham et al., 2013). Each of these moral domains is thought to function as an adaptation to recurring social problems and by doing so, help us understand our social world (see Table 1.1 for an overview of the moral domains and their evolutionary challenges).

Table 1.1
Names and descriptions of moral domains in the Moral Foundations Theory.

Names	**Concerns**
Purity	Contamination threats and violations of sanctity and chastity
Authority	Disobedience and disrespect towards authorities
Ingroup loyalty	Behaviors threatening the in-group, such as betrayal
Care	Harmful acts causing suffering or distress
Fairness	(A lack of) Cooperation and reciprocity
Liberty	Oppression and a lack of individual freedom

Note: Descriptions based on Haidt (2012); Haidt & Joseph (2007)

In this dissertation, moral purity concerns will be emphasized because of their evolutionary link to disgust. Both disgust and the purity domain are thought to have originated in response to the evolutionary challenge to stay clear of pathogens and parasites (Haidt, 2012). However, moral norms related to purity are thought to go beyond hygiene concerns alone and extend to serve a social function (Graham et al., 2009). That is, purity norms mark a group's cultural boundaries, preventing its members to engage in behaviors the group has determined are inhuman or profane. As such, homosexuality, abortion, euthanasia, or premarital sex are a few examples of issues that people disapprove of on the basis of purity concerns. Although these purity concerns do not revolve around physical contamination alone, some researchers have argued that the emotion of disgust is important in shaping the moral domain of purity (Graham et al., 2013). In Chapters 2 to 4, I will therefore investigate

whether individuals who are more disgust sensitive are also more sensitive to transgressions of the purity domain and why that may be the case.

Why do we need to know this?

There are two reasons why I think the questions raised in this dissertation are important. First, many societal and political issues are moral issues at their core. Gay marriage, euthanasia, immigration policies, abortion, gun control, social security, the death penalty. Individuals' support or opposition of these and many other issues is directly fueled by the moral norms and values they endorse. If we want to understand how different people get to strongly diverging opinions on important societal issues, we have to investigate the underlying motivations leading to these moral evaluations. While disgust has been identified as an important factor in the moral decision-making process, many questions regarding the nature of this association still remain (e.g., the ones I raised in the section "Disgust sensitivity", p. 12). Answering these, and related, questions could bring us one step closer to understanding and, subsequently, bridging political and societal divides.

Second, while some argue that disgust is a basic emotion (Darwin, 1872; Ekman, 1992), it remained largely understudied for a long time (see McKay, 2017). Researchers have focused more on disgust in the last few decades, immensely improving our understanding of this emotion. For example, many studies have shown the relevance of disgust sensitivity to psychological constructs, such as moral decision-making, political preferences, and psychopathological disorders (e.g., Horberg et al., 2009; Inbar, Pizarro, & Bloom, 2009; Inbar, Pizarro, Iyer, & Haidt, 2012; Olatunji, 2008; Shook, Oosterhoff, Terrizzi, & Brady, 2017; Terrizzi et al., 2010). However, a good understanding of the basic information processes underlying individual differences in disgust sensitivity is still missing. This raises some questions that need to be answered. For example, do individuals high and low in disgust sensitivity have

different information processes when encountering disgust stimuli? And are these biases specific to disgust stimuli or they do generalize to negative stimuli? Answers to these questions will help us understand what it means to be more or less disgust sensitive, which subsequently, will provide more insight into disgust sensitivity's relationships with, for example, moral decision-making.

Outline of the dissertation

The research presented in this dissertation has not been conducted by me alone and would not have looked the same without the help of my co-authors. The empirical chapters are therefore written in the "we-form". However, because the Introduction and General Discussion largely reflect my own thoughts they are written in the "I-form". The empirical chapters are based on individual papers that are either published or undergoing peer-review. They can be read separately or as a set of studies examining disgust sensitivity and its relationship to moral decision-making.

Chapter 2

This chapter focuses on the question whether the relationship between disgust sensitivity and moral judgments is domain-specific or exists across moral domains. In the morality literature, researchers have argued that disgust sensitivity is related to the moral domain of purity specifically. However, some research findings indicate that disgust sensitivity might be related to all so-called binding moral domains (i.e., moral domains facilitating group cohesion). Yet another, more recent, perspective argues that disgust sensitivity is not related to specific domains, but relates to moral judgments from all moral domains equally. In four exploratory studies, we show initial evidence for the first perspective: That disgust sensitivity is primarily related to moral judgments of the purity domain. We subsequently conducted a fifth study, which was highly powered and for which the

hypotheses and data analyses were preregistered. This study replicates the finding that disgust sensitivity is most strongly related to moral judgments of the purity domain.

Additionally, we discuss whether the presence of pathogen cues in purity moral transgressions might cause the strong relationship with disgust sensitivity. In two studies, we find that adding a pathogen cue to moral transgressions of the care or fairness norm does not strengthen their relationship to disgust sensitivity.

Chapter 3

In this chapter, we investigate two potential explanations for the domain-specific relationship between disgust sensitivity and moral judgments of purity. Critics of moral pluralism have questioned the existence of a meaningful moral domain of purity. They argue that all moral domains can be reduced to perceptions of harmfulness. According to them, the relationship between disgust and the moral domain of purity is not due to moral content, but can be attributed to weirdness. In this chapter, we therefore investigate whether perceptions of transgression weirdness and transgression harmfulness can account for the domain-specific effect of disgust sensitivity. Although both weirdness and harmfulness of a transgression explain part of the relationship between disgust sensitivity and moral judgments, they do not explain why disgust sensitivity is more strongly related to moral judgments of purity.

Chapter 4

While the previous chapter has shown that weirdness of moral transgressions cannot explain why disgust sensitivity relates more strongly to moral purity, we will flip the perspective in this chapter. Measures of disgust sensitivity are filled with atypical situations and it is therefore plausible that answers to these items are predictive of answers towards other weird situations, such as purity moral judgments. We find partial evidence for this idea. Weirdness of disgust sensitivity items is indeed predictive of moral judgments of

purity, but not care. However, re-analyzing the data of our earlier studies does not show a different relationship between disgust sensitivity and moral judgments of purity for highly weird or not so weird disgust sensitivity items.

Chapter 5

In the fifth chapter, we will look more closely at individual differences in disgust sensitivity and the attentional processes that they engender. From the literature, we know that this personality trait plays a role in many psychological constructs and psychopathological disorders. However, we know little about the basic underlying mechanisms of disgust sensitivity, such as information processing of disgust stimuli. By means of an eye tracker task, we will therefore investigate if individuals scoring high and low on disgust sensitivity have different visual attentional biases. We find they do demonstrate different reactions to encountering disgust stimuli, with more disgust sensitivity individuals showing a stronger avoidance reaction to disgust stimuli than less disgust sensitive individuals. Interestingly, this avoidance reaction is not only observed for disgust stimuli, but also for other negative stimuli.

Reproducible, Replicable, and Transparent Research

Since the start of my PhD project, a lot has and still is changing in the field of (social) psychology. Slowly, but steadily, the focus is shifting towards publishing reproducible, replicable, and transparent research. With these developments in mind, it seems appropriate to add a few sentences on how I, together with my co-authors, tried to improve the reproducibility, replicability, and transparency of the research presented in this dissertation.

Although power analyses were not always feasible given the multilevel nature of my analyses, a priori power analyses were conducted when possible. Elsewhere, we describe what rule was used to determine sample size. We also report all data exclusions (if any), all manipulations and conditions, and all measures used in each of

the studies. Predictions for some of our studies were preregistered. These preregistration files are available via the Open Science Framework, together with the questionnaires, data, and syntax used for data analysis of all studies published in this dissertation. Links to these materials for each of the studies can be found in the relevant empirical chapters.

2

Disgust sensitivity is primarily associated with purity-based moral judgments

Based on: Wagemans, F. M. A., Brandt, M. J., & Zeelenberg, M. (2018). Disgust sensitivity is primarily associated with purity-based moral judgments. *Emotion, 18,* 277-289.

Chapter 2

Abstract

Individual differences in disgust sensitivity are associated with a range of judgments and attitudes related to the moral domain. Some perspectives suggest that the association between disgust sensitivity and moral judgments will be equally strong across all moral domains (i.e., purity, authority, loyalty, care, fairness, and liberty). Other perspectives predict that disgust sensitivity is primarily associated with judgments of specific moral domains (e.g., primarily purity). However, no study has systematically tested if disgust sensitivity is associated with moral judgments of the purity domain specifically, more generally to moral judgments of the binding moral domains, or to moral judgments of all of the moral domains equally. Across five studies (total $N = 1{,}104$), we find consistent evidence for the notion that disgust sensitivity relates more strongly to moral condemnation of purity-based transgressions (meta-analytic $r = .40$) than to moral condemnation of transgressions of any of the other domains (range meta-analytic r's: $.07 - .27$). Our findings are in line with predictions from Moral Foundations Theory, which predicts that personality characteristics disgust sensitivity make people more sensitive to a certain set of moral issues.

Making moral judgments is in essence an emotional process (Haidt & Kesebir, 2010). Automatic intuitive evaluations guide our reasoning about and judgments of moral situations. One replicable effect from this perspective is the association between individual differences in disgust sensitivity and attitudes towards (morally) deviant behaviors or individuals (e.g., Brenner & Inbar, 2014; Chapman & Anderson, 2014; Crawford et al., 2014; Hodson & Costello, 2007; Inbar, Pizarro, & Bloom, 2009; Inbar, Pizarro, Knobe et al., 2009; Jarudi, 2009; Jones & Fitness, 2008; Naverrete & Fessler, 2006; Olatunji, 2008). People who score higher on trait disgust sensitivity tend to judge moral transgressions and other deviant behaviors as more morally wrong than people who score lower on this trait (e.g., Horberg et al., 2009). It is not clear, however, if this association is general or if it is specific to a limited set of moral situations. While some perspectives predict that disgust sensitivity will be primarily related to moral judgments in specific moral domains (e.g., Graham et al., 2013), other perspectives suggest that disgust sensitivity will be associated with judgments across multiple moral domains (e.g., Cameron, Lindquist, & Gray, 2015). However, to our knowledge, no study has tested these competing predictions by systematically comparing disgust sensitivity's effect on moral judgments across different moral domains. In five studies, we directly test if disgust sensitivity is related to moral judgments in the purity domain specifically, more generally to moral judgments in the binding moral domains, or to moral judgments in all of the moral domains.

Disgust & Disgust Sensitivity

Disgust is the feeling of revulsion in response to an aversive stimulus, motivating withdrawal from that stimulus (Rozin, Haidt, & McCauley, 2000). The word disgust is thought to essentially mean "something offensive to the taste" (Darwin, 1872, p. 257) and has been parsed into different disgust subtypes depending on the specific taste that is offended (Haidt et al., 1997; Tybur et al., 2009). For

example, one subtype is core disgust (sometimes called pathogen disgust) and it relates to the intake of potentially harmful foods. It likely evolved because it protects us from infectious diseases (Curtis & Biran 2001; Rozin et al., 2000; Tybur et al., 2013). However, disgust is also thought to be co-opted by the social and moral domains.

People experience disgust (along with anger, contempt, and other negative emotions) following moral transgressions (Brandt & Reyna, 2011; Cannon et al., 2011; Haidt et al., 1997). These feelings cue people into the moral transgression that has occurred and motivates them to take action. For example, one study shows that people make disgusted facial expressions after receiving unfair offers in an Ultimatum Game (Chapman et al., 2009). Similarly, neurological research shows that core disgust and moral/social disgust elicit activation in overlapping brain areas (Borg et al., 2008). The basic idea is that disgust, whether it is the core or the moral subtype, can arise from moral transgressions and biases behavior away from risks due to physical or social parasites (Curtis & Biran, 2001, also see Inbar & Pizarro, 2014). A more controversial proposition is that induced feelings of disgust amplify unrelated moral judgments (i.e., make unrelated moral judgments harsher; e.g., Schnall, Haidt et al., 2008; Wheatley & Haidt, 2005); however, a recent meta-analysis (Landy & Goodwin, 2015) and large scale replication attempts (Johnson et al., 2016) indicate that this effect is highly unstable and potentially very near zero.

Here, we sidestep that debate and focus on the association between individual differences in disgust sensitivity and moral judgments. Disgust sensitivity is an individual's proneness to experience disgust intensely or easily in response to aversive stimuli (also called trait disgust; Haidt et al., 1994). While state disgust can be very informative for specific situations, disgust sensitivity is stable over time and is predictive for a person's tendency to feel disgusted across a variety of disgust-eliciting stimuli and situations (Rozin, Haidt, McCauley, Dunlop, & Ashmore, 1999). People who score higher on disgust sensitivity tend to score higher on neuroticism

(Druschel & Sherman, 1999; Haidt et al., 1994; Tybur & De Vries, 2013) and a variety of fear-related measures, such as trait anxiety and animal phobia (De Jong & Merckelbach, 1998; Matchett & Davey, 1991; Muris, Merckelbach, Schmidt, & Tierney, 1999), and they tend to have higher perceptions of vulnerability to diseases (Duncan, Schaller, & Park, 2009).

Disgust sensitivity also has consistently been related to the moral domain. For example, it relates to people's moral values (i.e., the moral domains people think are most important; Graham et al., 2011; Van Leeuwen, Dukes, Tybur, & Park, 2017), the honesty-humility dimension of the HEXACO model of personality (Tybur & De Vries, 2013), and harsher punishments in a mock trial (Jones & Fitness, 2008). Although there has been a focus on investigating the association between disgust and moral cognition, some important questions are left unanswered. In this paper, we try to answer one such question. Namely, does disgust sensitivity relate to all kinds of moral judgments (i.e., the perceived wrongness of specific behaviors and situations), or is the association between disgust sensitivity and moral judgments domain specific? Although this question has elicited considerable discussion, no study, to our knowledge, has yet systematically tested the different perspectives in the literature against each other.

We will do so by focusing on moral judgments of concrete behaviors and situations, which is important for two reasons. First, they allow for the impact of so-called moral intuitions. Moral intuitions are the instant feelings of approval or disapproval that come with witnessing moral transgressions and are known to play a substantial role in moral decision-making (Haidt, 2001). An individual's moral intuition about a given situation is directly fueled by that individual's emotional disposition, such as disgust sensitivity. Because making moral judgments of specific situations more strongly triggers such moral intuitions than measures focused on broad and sometimes abstract moral concerns, such as the Moral Foundations Questionnaire (Graham et al., 2009; Graham et al., 2011), they

provide a more accurate reflection of how people make moral judgments in everyday life.

A second reason why it is important to focus on moral judgments of concrete behaviors concerns the five criteria set by Graham and colleagues (2013, p. 37) that determine what counts as a moral domain. The first of these criteria is "a common concern in third-party normative judgments". More specifically, they argue that the existence of a domain can be doubted if there is a lack of response to third-party transgressions of that domain, even when people claim to endorse that broad moral concern. The idea behind this criterion is that people are motivated to enforce a certain norm, even when there are no direct implications for the self, thereby showing shared intentionality to uphold a certain norm. In order to show domain specific effects, it is therefore crucial to focus on moral judgments of third-party transgressions of these moral domains.

Disgust Sensitivity & Domains of Moral Judgment: Three Hypotheses

Taxonomies of moral content suggest that the moral domain can be split into anywhere from three (Shweder et al., 1997), to five (Graham et al., 2009) and six (Haidt, 2012; Janoff-Bulman & Sheikh, 2012) moral domains. Some have argued against the existence of distinct moral domains, suggesting that all domains are a variation of one underlying construct (i.e., perceived harm; Schein & Gray, in press). Although there are theoretical benefits and drawbacks to each of these taxonomies, in this paper we focus on the Moral Foundations taxonomy (for an overview, see Graham et al., 2013) because this perspective has most closely considered the role of disgust and is one of the most widely used taxonomies. The taxonomy from Moral Foundations Theory includes three domains that are often lumped together as binding foundations (i.e., moral domains that bind groups together and facilitate group cohesion; Haidt, 2008) and three domains that are often lumped together as individualizing foundations (i.e., moral domains that facilitate individual rights and

responsibilities; Haidt, 2008). These six domains are listed and briefly described in Table 2.1. It is not clear how disgust sensitivity predicts moral judgments across these six domains. The moral psychology literature provides three, yet untested, hypotheses about the relation between disgust sensitivity and moral judgments in these domains.

Table 2.1
Names and descriptions of moral domains in the Moral Foundations Theory.

Names	Type of Domain	Description
Purity	Binding	Concerns contamination threats and violations of sanctity and chastity
Authority	Binding	Concerns disobedience and disrespect towards authorities
Loyalty	Binding	Concerns behaviors threatening the in-group, such as betrayal
Care	Individualizing	Concerns harmful acts causing suffering or distress
Fairness	Individualizing	Concerns (a lack of) cooperation and reciprocity
Liberty	Individualizing	Concerns oppression and a lack of individual freedom

Note: Descriptions based on Haidt (2012); Haidt & Joseph (2007)

Primarily Purity Hypothesis. The primarily purity hypothesis is the most specific hypothesis and predicts that disgust sensitivity will be associated with harsher judgments of moral transgressions of the purity domain more so than with judgments of moral transgressions in any of the other domains. This hypothesis is consistent with Moral Foundations Theory, which was developed to explain why some cultures or people are more sensitive to one set of moral issues, but not to other sets of moral issues (Graham et al.,

2013). The degree to which one is morally sensitive to each of these domains depends on both cultural upbringing and personality. Disgust sensitivity is one such personality trait, and is thought to sensitize people to judgments in the purity domain because the concerns most relevant to the purity domain likely result from the same evolutionary problems as disgust. More specifically, Haidt (2012, p. 146) notes that "the original adaptive challenge that drove the evolution of the sanctity (i.e., purity) domain […] was the need to avoid pathogens, parasites, and other threats that spread by physical touch or proximity" and even goes as far as saying that "if we had no sense of disgust, I believe we would also have no sense of the sacred" (Haidt, 2012, pp. 173-174). The shared motivation of to avoid any potential threat of physical and mental contamination makes it likely that people most prone to experience disgust will also render the harshest judgment of purity-related moral transgressions (Haidt, 2012; Haidt & Graham, 2007; Horberg, Oveis, & Keltner, 2011; Rozin, Lowery et al., 1999).

This claim that disgust sensitivity relates to moral issues in the purity domain specifically, is consistent with some empirical studies in both moral and political psychology. Individual differences in trait disgust sensitivity predict opposition to gay marriage, abortion, and premarital sex (Inbar, Pizarro, Knobe et al., 2009; Smith et al., 2011), and people scoring higher on disgust sensitivity have more conservative attitudes towards homosexuality and other threatening or non-traditional sexual practices (Crawford et al., 2014; Inbar, Pizarro, & Bloom, 2009; Jarudi, 2009; Olatunji, 2008). These political issues all have been linked with the purity domain (Koleva, Graham, Haidt, Iyer, & Ditto, 2012). More directly, Horberg and colleagues (2009) find that while disgust sensitivity is positively related to punishment of purity transgressions, it has no such relation to punishment of justice transgressions. These studies support the possibility that disgust sensitivity is most strongly related to moral judgments in the purity domain compared to all of the other moral domains.

Primarily Binding Hypothesis. The primarily binding hypothesis is less specific than the first hypothesis and predicts that disgust sensitivity is a better predictor of judgments of all the binding moral domains than of judgments of the individualizing moral domains. There are at least three reasons for making this prediction. First, the binding domains are focused on increasing social cohesiveness and social order, and moral cognition in these domains is correlated with a preference for intuitive and emotional thinking (Garvey & Ford, 2014). Garvey and Ford also find that the individualizing moral domains (i.e., domains that concern the protection of the individual against harm and injustice) are more strongly related to a preference for rational thinking. More directly, they find that disgust sensitivity is correlated with support for moral values in all three binding moral domains, but not to moral values in any of the individualizing moral domains. Although this provides some indication that disgust sensitivity might be correlated more strongly to moral judgments of the binding moral domains, moral values do not correspond perfectly to moral judgments of specific situations (e.g., endorsing the moral principle of 'do no harm' does not mean that there are no instances in which inflicting some harm is permissible; Clifford, Iyengar, Cabeza, Sinnott-Armstrong, 2015). It should therefore be tested if disgust sensitivity has a similar relation to moral judgments tapping into the binding moral domains.

Second, disgust sensitivity has been associated with maintaining a clear separation between the in-group and out-groups. The idea is that, evolutionarily speaking, out-groups provide a threat of disease that people who are disgust sensitive are particularly tuned for. People who score high on disgust sensitivity then may be more concerned with moral issues and judgments that help to bind the in-group together and maintain separation from out-groups. Consistent with this idea, Naverrete and Fessler (2006) show that higher scores on disgust sensitivity relate not only to more negative perceptions of an out-group, but also to more positive perceptions of the in-group. Furthermore, disgust sensitivity predicts one's stance on issues related

to in-group protection, such as immigration, and attitudes towards foreign and socially deviant groups (Brenner & Inbar, 2014; Hodson & Costello, 2007). More disgust sensitive people agree more with statements such as “immigrants are a threat to our society” and “immigrants bring more crime”, and are also more in favor of severe punishments for criminal offenders (Brenner & Inbar, 2014).

Third, disgust sensitivity has been associated with overall support for political conservative ideologies and belief systems (Inbar et al., 2012; Terrizzi et al., 2010; Tybur et al., 2016). The binding moral domains are the domains most clearly associated with conservatism (Graham et al., 2009). If disgust sensitivity is associated with more conservative moral judgments overall, then it should be related to harsher judgments across the three binding domains as well.

Considering all these findings, it is surprising that no study yet has directly compared disgust sensitivity’s association with moral judgments in each of the binding moral domains. As described above, previous research did show that disgust sensitivity’s association with purity judgments is stronger than its association with judgments of individualizing moral domains (i.e., Horberg et al., 2009), but this finding would also be in line with predictions following from a primarily binding hypothesis as it cannot distinguish a purity domain specific effect from a binding domain specific effect. Therefore a study that includes multiple binding domains is necessary to distinguish between the primarily purity hypothesis and the primarily binding hypothesis.

Equal Strength Hypothesis. The most general hypothesis is the equal strength hypothesis, which predicts that disgust sensitivity relates to moral judgments in all domains equally. Admittedly, there is less support for this particular hypothesis, but it is hinted at by several perspectives. For example, constructivist perspectives on emotions suggest that emotions are not specifically tied to moral transgressions in any specific domain (Cameron et al., 2015). In a reanalysis of Hofmann and colleagues’ (Hofmann, Wisneski, Brandt,

& Skitka, 2014) data, Cameron and colleagues (2015) found that people experience as much disgust in response to purity transgressions as in response to harm transgressions. More directly, Chapman and Anderson (2014) have found that disgust sensitivity relates positively to condemnation of care transgressions, one of the individualizing moral domains. In addition, it has been found that more disgust sensitive participants are more likely to judge a suspect as guilty and, subsequently, propose harsher sentences (Jones & Fitness, 2008). Importantly, this latter study found no differences for disgusting compared to non-disgusting crimes. The key idea uniting all of these findings is that disgust is negative input into the moral judgment process and so, in turn, leads to harsher moral judgments regardless of the domain (Brandt & Reyna, 2011; Clore & Palmer, 2009).

The Current Studies

We present five studies in which we investigated the domain specificity of the relation between disgust sensitivity and moral judgment, by testing the three mutually exclusive hypotheses described above. Distinguishing between these three hypotheses will help lend support for theories in moral psychology that emphasize the importance (e.g., Graham et al., 2013) or the paucity (e.g., Gray, Young et al., 2012) of moral domains.

One downside of moral judgment research is that researchers typically use unstandardized and ad hoc scenarios with unknown validity (e.g., Schnall, Haidt et al., 2008; Wheatley & Haidt, 2005). This makes it difficult for researchers to test for the effects of emotions on moral judgments across domains (Clifford et al., 2015; Horberg et al., 2009). Therefore, we use moral judgments drawn from the Moral Foundations Vignettes (Clifford et al., 2015). This set of vignettes provides a standardized and validated set of moral judgments that spans much of the moral domain as proposed by Moral Foundations Theory, thereby solving common problems resulting from using unstandardized scenarios.

Studies 2.1 - 2.4

In four similar studies, we tested the relationship between disgust sensitivity and moral judgments. These data were originally collected for other purposes[1], but can be used to provide an initial test of the three competing hypotheses. In Study 2.1 and Study 2.2 we included a measure of trait anger (Spielberger, 1999) and were able to use this to test if the effects we observe are specific to disgust.

Method

The four studies were similar in design, so they are described together and deviations are highlighted. In all studies, disgust sensitivity was measured with the 27-item Disgust Sensitivity Scale-Revised (DS-R; Haidt et al., 1994, modified by Olatunji, Williams et al., 2007). The first 14 items are answered on a 5-point scale ranging from 0 = 'Strongly disagree (very untrue about me)' to 4 = 'Strongly agree (very true about me)'. An example item is "If I see someone vomit, it makes me sick to my stomach". The remaining 13 items are answered on a 5-point scale ranging from 0 = 'Not disgusting at all' to 4 = 'Extremely disgusting'. An example item of this part of the scale is "You see maggots on a piece of meat in an outdoor garbage pail". The scale has two filler items that are excluded from the analyses. See Table 2.2 for the reliability of this scale and the other scales used in these studies.

In Study 2.1 and Study 2.2, individual differences in trait

[1] The exact materials that were used in all studies and the relevant datasets can be found in the supplemental materials at the Open Science Framework (OSF; Supplemental Materials via https://osf.io/dspvr/). Studies 2.1 to 2.4 included additional measures of potential moderators (i.e., private body consciousness, emotion regulation strategies) and mediators (i.e., sensitivity to deviance, approach and avoidance strategies) that ultimately did not moderate or mediate the relationships. The data of these studies have not been published elsewhere and can be found at the OSF.

anger were measured with the State-Trait Anger Expression Inventory-2 (STAXI; Spielberger, 1999). The STAXI has been used in previous research related to moral cognition (Horberg et al., 2009; Jones & Fitness, 2008) and is a well-validated measure of trait anger that relates to a variety of anger and aggression expressions (e.g., Barbour, Eckhardt, Davison, & Kassinove, 1998; Forgays, Forgays, & Spielberger, 1997; Wang, Yang, Yang, Wang, & Lei, 2017; Wittmann, Arce, & Santisteban, 2008). In the current research, only the 10-item trait anger subscale was used. All questions were answered on a 4-point scale ranging from 1 = '(Almost) Never' to 4 = '(Almost) Always'. An example item is 'I have a fiery temper'.

In all studies, moral transgressions were taken from a standardized set of vignettes based on Moral Foundations Theory (Clifford et al., 2015). This measure was chosen as it is the first set of moral judgments that is well-validated. Items are developed based on domain specific characteristics, and were categorized by subjects as belonging to a certain moral domain. Participants could also indicate that an item was not morally wrong, making sure that each transgression is considered to be violating a moral, instead of a social, norm. The authors conducted both exploratory as well as confirmatory factor analyses on moral judgments of these items to ensure that each item is a distinct indicator of a moral domain. Additionally, the moral judgment items in this set are controlled for comprehensibility, frequency of the act, imaginability, and strength of the emotional response they elicit. The set includes moral transgressions from six moral domains: care, fairness, authority, loyalty, liberty, and sanctity (which we, for sake of consistency, will refer to as purity from now on). Example items are "you see a woman clearly avoiding sitting next to an obese woman on the bus" (care domain) and "you see a story about a remote tribe eating the flesh of their deceased members" (purity domain). Participants indicated for each moral transgression how immoral they found the behavior on a scale ranging from 1 = 'Not at all immoral' to 7 = 'Extremely immoral', unless specified otherwise. The number of moral

transgressions and the number of moral domains they represent vary across studies.

Study 2.1. Eighty Dutch students (58 females, M_{age} = 19.55, SD = 1.48) participated in this study, as part of a series of studies, in return for course credit. Sample size was based on the number of students that wanted to participate in our lab study during one week. They first filled out the disgust sensitivity scale and then provided judgments of eight moral transgressions, equally divided over four moral domains: purity, authority, care, and fairness.

Study 2.2. Participants were recruited via social media and online fora. We planned to recruit a minimum of 200 participants. In the end, two-hundred twenty-one Dutch participants completed the entire questionnaire (171 females, 48 males, 2 unknown, M_{age} = 31.45, SD = 13.92). Participants first filled out the disgust sensitivity scale and then proceeded with the moral judgments. Participants not only indicated how immoral they found each transgression, but they also indicated to what extent they would like to punish the person for his/her behavior (1 = 'Not at all' to 7 = 'Very much so'). Participants made these judgments for ten transgressions from different moral domains; three purity, two authority, three care, and two fairness items.

Study 2.3. Two-hundred and four Dutch students (161 females, M_{age} = 19.43, SD = 1.86) participated in this study, as part of a series of studies, in return for course credit. Sample size was based on the number of students that wanted to participate in our lab study during two weeks. They filled out the disgust sensitivity scale and rated the same ten moral transgressions on immorality as in Study 2.2.

Study 2.4. One-hundred and forty-eight Dutch students (119 females, M_{age} = 19.97, SD = 2.29) were recruited on campus and participation was voluntary. Sample size was based on the number of students that wanted to participate in our study during one week. The disgust sensitivity scale was filled out first followed by eight moral transgressions: four purity, two care, and two fairness items.

Results and Discussion

Primary Analyses. Path analysis was used to estimate and compare the strength of the relationship between disgust sensitivity and judgments of moral transgressions of all the moral domains. These analyses were conducted using the 'sem' function in the 'lavaan' package of R (Rosseel, 2012). See Table 2.2 for an overview of means, standard deviations, and correlations between all subscales described in this section.

First, a free model including disgust sensitivity as a predictor and all moral domains as outcome variables was fitted.[2] The unstandardized estimates from this model per dataset are in Figure 2.1. It appears that across the four samples disgust sensitivity is a stronger predictor of immorality and punishment ratings of purity transgressions than ratings of transgressions in the other domains. Similarly, the other binding domain (i.e., authority) looks approximately equal in strength to the individualizing domains. These initial impressions are consistent with the primarily purity hypothesis, but not with the equal strength or the primarily binding hypotheses.

To test these impressions, we next compared the free model with the "all equal" model in which all paths between disgust sensitivity and the moral domains are constrained to be equal. Chi-square tests show that the all equal model fits the data significantly worse than the free model in all four studies (see Table 2.3). This suggests that there are significant differences in the strength of the paths depending on the moral domain. To directly assess the validity of the primarily binding and primarily purity hypotheses we compared the free model to models in which pairs of paths between disgust sensitivity (DS) and judgments in one of the moral domains are constrained to be equal (see Table 2.3 for hypothesis-relevant constraints).

[2] This is a saturated model, therefore, no fit indices are reported for this model.

Table 2.2

Correlation matrix of disgust sensitivity, trait anger, and all moral judgments per domain, per study.

	***M* (*SD*)**	**α**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Study 2.1 (N = 80)									
1. Disgust Sensitivity	2.01 (0.54)	.85	.19	**.43**	.14	.11	-.08		
2. Trait Anger	1.86 (0.45)	.84		.12	-.05	-.06	-.01		
3. Purity	4.56 (1.35)	$.20_a$			*.23*	*.25*	.09		
4. Authority	4.18 (0.98)	$.42_a$				.20	**.46**		
5. Care	5.53 (0.94)	$.13_a$					**.37**		
6. Fairness	5.58 (0.91)	$.18_a$							
Study 2.2 – Immorality (N = 221)									
1. Disgust Sensitivity	1.97 (0.64)	.88	**.19**	**.27**	-.10	-.06	.01		
2. Trait Anger	1.76 (0.41)	.79		-.06	*-.16*	.08	-.04		
3. Purity	4.23 (1.46)	.63			**.21**	**.25**	.11		
4. Authority	4.39 (1.27)	$.44_a$				**.23**	**.39**		
5. Care	5.24 (0.94)	.43					**.36**		
6. Fairness	5.92 (0.81)	$.25_a$							

Table 2.2 (continued)

	M (*SD*)	α	2	3	4	5	6	7	8
Study 2.2 – Punishment (*N* = 221)									
1. Disgust Sensitivity	1.97 (0.64)	.88	**.19**	**.38**	-.05	*.15*	.10		
2. Trait Anger	1.76 (0.41)	.79		.11	-.05	*.14*	.11		
3. Purity	2.55 (1.30)	.62			**.31**	**.37**	**.32**		
4. Authority	3.75 (1.48)	$.39_{a}$				**.29**	**.52**		
5. Care	4.49 (1.33)	.57					**.46**		
6. Fairness	5.31 (1.37)	$.47_{a}$							
Study 2.3 (*N* = 204)*									
1. Disgust Sensitivity	2.05 (0.54)	.84		**.44**	.14	**.34**	.10		
3. Purity	4.34 (1.32)	.63			**.18**	**.27**	.10		
4. Authority	5.32 (1.03)	$.30_{a}$				**.37**	**.38**		
5. Care	5.30 (0.88)	.47					**.27**		
6. Fairness	5.75 (0.81)	$.27_{a}$							
Study 2.4 (*N* = 148)* $^{+}$ **									
1. Disgust Sensitivity	2.03 (0.53)	.84		**.39**		**.35**	.08		
3. Purity	4.62 (1.02)	.63				**.30**	.11		
5. Care	6.35 (0.72)	$.08_{a}$					**.23**		
6. Fairness	6.02 (0.89)	$.25_{a}$							

Table 2.2 (continued)

	M (*SD*)	α	2	3	4	5	6	7	8
Study 2.5 (*N* = 451)*									
1. Disgust Sensitivity	2.07 (0.63)	.87		**.41**	**.29**	**.32**	**.15**	**.30**	**.12**
3. Purity	4.79 (1.48)	.91			**.56**	**.54**	**.33**	**.53**	**.22**
4. Authority	3.27 (1.22)	.92				**.69**	**.38**	**.81**	**.52**
5. Care	4.27 (1.27)	90					**.48**	**.61**	**.66**
6. Fairness	5.09 (1.08)	.90						**.25**	**.47**
7. Loyalty	3.09 (1.26)	.92							**.45**
8. Liberty	3.92 (1.27)	.90							

Correlations in italics $p < .05$, correlations in bold $p < .01$

Note: Table includes means (*M*), standard deviations (*SD*), and reliabilities (α) of all subscales per study. All items were measured on a 7-point scale (1-7), except for Disgust Sensitivity, which was measured on a 5-point scale (0-4) and Trait Anger, which was measured on a 4-point scale (1-4). Reliability estimates with an $_{a}$ indicate correlations.

* Trait Anger was only measured in Study 2.1 and Study 2.2.

** The Authority domain was not measured in Study 2.4.

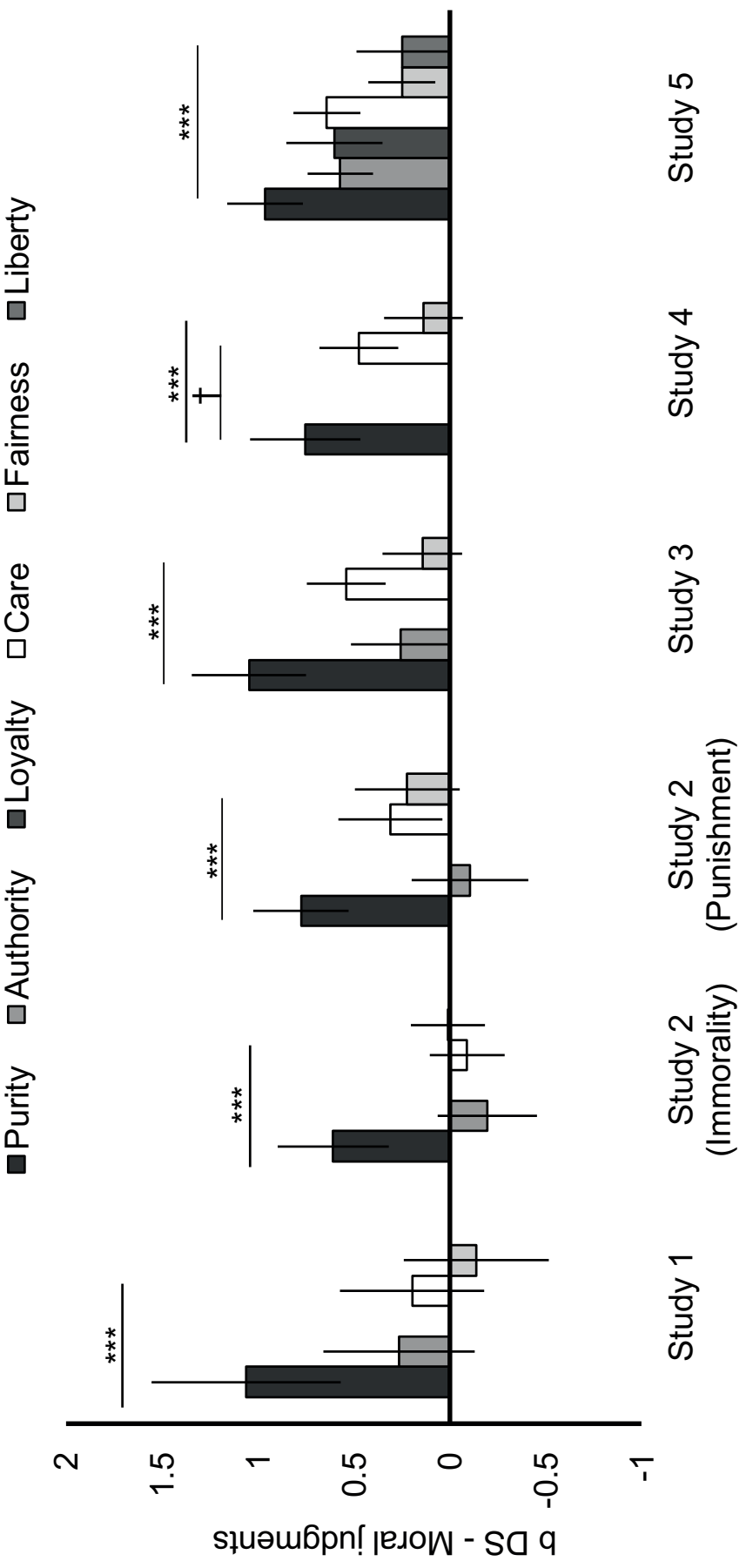


Figure 2.1. Unstandardized regression coefficients (b) and 95% confidence intervals for the relation between disgust sensitivity and moral judgments for each moral domain per study, † $p = .09$, *** $p < .001$.

Table 2.3

Chi-square tests comparing the free, unconstrained, model with models constraining paths to be equal (depending on which hypothesis is tested: Equal Strength Hypothesis, the Primarily Purity Hypothesis, and the Primarily Binding Hypothesis).

	All Equal χ^2 (df)	P-A Equal χ^2	P-Lo Equal χ^2	P-C Equal χ^2	P-F Equal χ^2	P-Li Equal χ^2	A-C Equal χ^2	A-F Equal χ^2	A-Li Equal χ^2	Lo-C Equal χ^2	Lo-F Equal χ^2	Lo-Li Equal χ^2
Studies 2.1 – 2.4		df=1	df=1	df=1	df=1	df=1	df=1	df=1	df=1	df=1	df=1	df=1
Study 2.1	**15.76** (3)	**7.18**		**8.97**	**15.38**		0.07	3.96				
Study 2.2 – Immorality	**26.25** (3)	**20.82**		**19.68**	**13.18**		0.51	2.63				
Study 2.2 – Punishment	**28.73** (3)	**27.78**		**9.08**	**11.67**		*5.59*$_a$	*4.98*$_a$				
Study 2.3	**27.19** (3)	**17.34**		**8.53**	**24.52**		*4.25*$_a$	0.75				
Study 2.4	**9.90** (2)			2.93	**9.76**							

Table 2.3 (continued)

	All Equal χ^2 (df)	P-A Equal χ^2	P-Lo Equal χ^2	P-C Equal χ^2	P-F Equal χ^2	P-Li Equal χ^2	A-C Equal χ^2	A-F Equal χ^2	A-Li Equal χ^2	Lo-C Equal χ^2	Lo-F Equal χ^2	Lo-Li Equal χ^2
		df=1	df=1	df=1	df=1	df=1	df=1	df=1	df=1	df=1	df=1	df=1
Study 2.5	**52.18** (5)	**16.78**	**13.29**	**10.55**	**41.96**	**32.05**	0.90	**11.49**	**12.72**	0.24	**10.85**	**12.79**

Chi-squares in italics $p < .05$, chi-squares in bold $p < .01$

Note: df = degrees of freedom, P = Purity, A = Authority, Lo = Loyalty, C = Care, F = Fairness, Li = Liberty.

E.g., "P-A Equal" displays a model comparison between the free, unconstrained, model and a model in which the path between disgust sensitivity and the purity domain is constrained to be equal to the path between disgust sensitivity and the authority domain.

For $_{a,}$ the path coefficient of disgust sensitivity and the authority domain is significantly weaker than the path coefficient of disgust sensitivity and moral judgments of the tested moral domain (contradictory to the primarily binding hypothesis).

The primarily purity hypothesis predicts that constraining the DS-purity link to be equal to any of the DS-moral domain links will result in poorer fit as a result of a stronger DS-purity association. Consistent with this hypothesis, across 13 of the 14 relevant model comparisons the constraint significantly hurt model fit. In the remaining relevant comparison (in Study 2.4 where the DS-purity link is compared to the DS-care link), the effect was in the direction consistent with the primarily purity hypothesis, but the constraint was not significant ($p = .09$).

The primarily binding hypothesis is an expanded version of the primarily purity hypothesis. It also predicts that the DS-purity link will be stronger than the DS-care and DS-fairness links; however, it differs in that it predicts that the DS-authority link will be larger than the DS-care and the DS-fairness links as well and similar in size to the DS-purity link. The prior paragraph showed that the DS-authority link was never similar in strength to the DS-purity link. The additional comparisons between the DS-authority link and both DS-fairness and DS-care links were not any more supportive of the hypothesis. Three of the eight constraints significantly hurt model fit, but were in the opposite direction of the predictions following from the primarily binding hypothesis (e.g., the DS-authority link is significantly *weaker* than the DS-care link in Study 2.4). Only one of the eight constraints significantly hurt model fit and was in the expected direction (i.e., the DS-authority link is significantly different from the DS-fairness link in Study 2.2); however, the DS-authority link in this case did not differ from zero. The remaining four constraints did not hurt model fit, showing no difference in strength for these links. The primarily binding hypothesis was thus not supported. Overall, the results provide most support for the primarily purity hypothesis.

Additional Analyses. In Study 2.1 and Study 2.2 we were able to use the same model comparison approach as just described, but also control for trait anger. See Table 2.2 for an overview of means and standard deviations of trait anger, and correlations of trait anger with all subscales. To control for trait anger, a model including

disgust sensitivity and trait anger as predictors and all moral domains as outcome variables was fitted. Subsequently, the same constraints were applied to the association between disgust sensitivity and moral judgments as described above. Adding trait anger to the models did not change the results of any but two model comparisons. In both cases, adding trait anger to the model affected the comparison between the free model and the model in which the DS-authority and DS-fairness links were constraint to be equal. In Study 2.1, the initial model comparison showed that the DS-authority and DS-fairness links did not differ in strength, but when controlling for trait anger, the DS-authority link was found to be significantly stronger than the DS-fairness link ($\chi^2[1, N = 80] = 4.41, p = .04$). However, for the punishment data in Study 2.2 the exact opposite happened when controlling for trait anger. While the DS-authority link was initially stronger than the DS-fairness link, including trait anger made both links equal in strength ($\chi^2[1, N = 221] = 3.32 , p = .07$). Importantly though, adding trait anger to the models did not change our conclusion that disgust sensitivity is more strongly related to the purity domain than to any of the other moral domains. Because the inclusion of trait anger did not affect our conclusion, we did not include it in our final study. [3]

Study 2.5

In the first four studies, we found that disgust sensitivity is more strongly associated with purity moral judgments than to moral judgments in the authority, care, and fairness domains. This provides support for the primarily purity hypothesis and contradicts the equal strength and primarily binding hypotheses. However, these findings might be related to the specifics of the studies. For example, purity judgments tended to have higher reliability than judgments in other

[3] See Supplemental Materials for all model comparisons, with and without controlling for trait anger.

domains (e.g., care in Study 2.4). The low reliabilities may be due to the characteristics of our particular samples (i.e., from The Netherlands) compared to the samples used to create the stimuli (i.e., from the United States; Clifford et al., 2015) or because we used a relatively small number of moral judgments. Another constraint of our studies is that we only included one other binding moral domain (authority) in addition to purity. It may be the case that loyalty moral judgments, the third binding moral domain, are also particularly strongly associated with disgust sensitivity. Disgust and disgust sensitivity have been shown to predict opposition to out-groups in order to protect the in-group from the potential disease threat out-groups are believed to possess (Brenner & Inbar, 2014; Hodson & Costello, 2007) and so by not including loyalty judgments we might have overstated our case. We also did not include any judgments regarding liberty or freedom, a domain that people appear to consider moral (e.g., Clifford et al., 2015; Graham et al., 2013; Haidt, 2012; Hoffman et al., 2014; Iyer, Koleva, Graham, Ditto, & Haidt, 2012). Finally, we did not originally set out to test these particular hypotheses with these first four studies and therefore sought out to directly test our hypothesis with more reliable measures of moral judgments across a wider array of moral judgments. This study and our expectation that the primarily purity hypothesis would receive most support was preregistered at the Open Science Framework before data collection started.[4]

Method

Participants. Based on the findings in our previous studies,[5] a conservative a priori power analysis was conducted using G*Power

[4] See Supplemental Materials for all preregistration files.

[5] This includes the first four studies in this article, plus an additional study that accidentally excluded 7 disgust sensitivity items and included repeats of another 7 disgust sensitivity items. We analyzed this data without the repeated items and used the conclusions to inform our power analyses (see Supplemental Materials, Study 2.5A).

(Faul, Erdfelder, Lang, & Bucher, 2007) to detect a difference in slope of .158. This suggested that a sample size of 424 participants was necessary to achieve power of 90%. Therefore, we aimed for at least 450 participants, recruited via Amazon Mechanical Turk. In the end, 451 MTurkers (208 females, 242 males, 1 other, M_{age} = 35.31, *SD* = 10.66) completed our study in return for a financial reward.

Materials. Disgust sensitivity was measured with the same scale as in Studies 2.1 to 2.4 (i.e., DS-R; Haidt et al., 1994, modified by Olatunji, Williams et al., 2007). Sixty moral transgressions were taken from the same item set as in Studies 2.1 to 2.4 (Clifford et al., 2015), ten from each moral domain. All moral domains had high reliabilities (see Table 2.2). Participants indicated to what extent they found each moral transgression immoral on a scale ranging from 1 = 'Not at all immoral' to 7 = 'Extremely immoral'.

Results

See Table 2.2 for an overview of means, standard deviations, and correlations between all subscales. Our pre-registered, confirmatory analyses used the same data analytic strategy as in Studies 2.1 to 2.4. First, a free model including disgust sensitivity as a predictor and all moral domains as outcome variables was fitted (for the unstandardized estimates, see Figure 2.1). To test the equal strength hypothesis, we compared the free model with the "all equal" model in which all paths between disgust sensitivity and moral domains are constrained to be equal. Contradictory to what is expected according to the equal strength hypothesis, a chi-square test shows that the all equal model fits the data significantly worse than the free model, suggesting that some moral domains are significantly stronger related to disgust sensitivity than others (see Table 2.3). As in Studies 2.1 to 2.4, we assessed the validity of the primarily purity and primarily binding hypotheses by comparing the free model to models in which pairs of paths between disgust sensitivity (DS) and judgments in one of the moral domains are constrained to be equal (see Table 2.3 for hypothesis-relevant constraints).

To test the primarily purity hypothesis, the free model was compared to models in which the DS-purity link is constrained to be equal to each of the other DS-moral domain links. All five alternative models resulted in poorer model fit, showing that the DS-purity link is significantly stronger than any of the other links between disgust sensitivity and one of the moral domains, thereby supporting the primarily purity hypothesis.

The primarily binding hypothesis predicts that the DS-purity, DS-authority, and DS-loyalty links will be stronger than the DS-care, DS-fairness, and DS-liberty links. Although the previous paragraph already showed that the DS-purity link is stronger than both the DS-authority and DS-loyalty links, we continued to test support for the primarily binding hypothesis by comparing the additional relevant paths for the DS-authority and DS-loyalty links. Four of these six constraints indeed significantly hurt model fit in the expected direction. The DS-authority and DS-loyalty links were significantly stronger than the DS-fairness and DS-liberty links. However, contrary to the primarily binding hypothesis, constraining the DS-authority and DS-loyalty link to be equal to the DS-care link did not significantly hurt model fit, suggesting they are equal in strength. The primarily binding hypothesis is therefore not fully supported. In line with Studies 2.1 to 2.4 and in line with our preregistered expectations, most support was found for the primarily purity hypothesis.[6]

Internal Meta-Analysis

An internal meta-analysis was conducted to analyze the association between disgust sensitivity and purity moral judgments,

[6] We conducted an exploratory test of political ideology as a mediator between disgust sensitivity and moral judgments of purity. While we replicated the pattern reported by Clifford and colleagues (2015) regarding the relation between political ideology and each of the moral domains, we find no relation between political ideology and disgust sensitivity (in line with results reported for pathogen disgust in Van Leeuwen et al., 2017).

as compared to the other moral domains, across all our studies. The meta-analysis was conducted using the 'rma' function in the 'metafor' package of R (Viechtbauer, 2010). For all studies, the correlations between disgust sensitivity and judgments in all the moral domains were included using Fisher *r*-to-*z* transformations. In addition to the five studies above, we also included an additional study where we accidentally excluded 7 disgust sensitivity items and included repeats of another 7 disgust sensitivity items (see Footnote 5). We analyzed this data without the repeated items (see Supplemental Materials, Study 2.5A) to include it in the meta-analysis. The correlations related to the punishment judgments of Study 2.2 were not included because these items do not have multiple measurements across our studies.

A fixed-effects model confirms that there is a significant relation between disgust sensitivity and moral judgments across all of the moral judgments ($r = .26$, $p < .001$). To test the equal strength hypothesis, moral domain was added to the model as a moderator. Contrary to what the equal strength hypothesis would predict, moral domain moderates the effect ($Q_M[5] = 86.796$, $p < .001$), showing that the strength of the effect differs depending on type of moral domain.

To test the primarily purity hypothesis, the DS-purity link was taken as the reference category against which all other links were tested. Additionally, country where the study took place was added as a moderator to account for the differences in strength of the relations (i.e., the relation between disgust sensitivity and moral judgments seemed stronger across all moral domains in the US samples than in the Dutch samples). By adding it as a moderator we can control for this. Conclusions remained the same without this moderator added to the model. Consistent with the primarily purity hypothesis, the DS-purity link ($r = .40$) was found to be significantly stronger than all other links between disgust sensitivity and judgments of moral domains (DS-authority: $r = .19$; $z = -5.95$, $p < .001$; DS-loyalty: $r = .24$; $z = -4.00$, $p < .001$; DS-care: $r = .27$; $z = -4.08$, $p < .001$; DS-

fairness: r = .11; z = -8.46, p < .001; DS-liberty: r = .07; z = -7.66, p < .001).

Next, we tested the primarily binding hypothesis that disgust sensitivity is more strongly related to moral judgments in the binding domains (i.e., purity, authority, and loyalty) than in the individualizing domains (i.e., care, fairness, and liberty). The previous paragraph shows that the DS-purity link is stronger than any other DS-moral domain links, regardless of whether the domain is classified as individualizing or binding. To test whether the DS-authority link is stronger than the link between disgust sensitivity and the individualizing moral domains, the DS-authority link was taken as the reference category. Controlling for country, the DS-authority link proved to be significantly stronger than both the DS-fairness (z = -2.16, p = .03) and DS-liberty (z = -2.62, p = .009) links, but significantly weaker than the DS-care link (z = 2.04, p = .04). Taking the DS-loyalty link as the reference category revealed a similar pattern. The DS-loyalty link proved to be significantly stronger than both the DS-fairness (z = -2.81, p = .005) and DS-liberty (z = -3.33, p < .001) links, but equal in strength to the DS-care link (z = 0.71, p = .48). The primarily binding hypothesis was thus not fully supported. Again, most support was found for the primarily purity hypothesis.

General Discussion

The relation between individual differences in disgust sensitivity and attitudes related to the moral domain is well established (e.g., Crawford et al., 2014; Inbar, Pizarro, Knobe et al., 2009; Jones & Fitness, 2008; Naverrete & Fessler, 2006). A question that remained unanswered, however, is whether this association between disgust sensitivity and morality is general or if it is specific to a certain set of moral domains. We derived three plausible hypotheses from the literature. The primarily purity hypothesis states that disgust sensitivity is more strongly related to moral judgments in the purity

domain than to moral judgments in any of the other moral domains. The primarily binding hypothesis takes a somewhat broader perspective by distinguishing binding from individualizing moral domains and predicts that disgust sensitivity is primarily related to judgments in the binding moral domains. The last and most general hypothesis, the equal strength hypothesis, however, predicts that disgust sensitivity relates to moral judgments across all domains equally.

In five studies, including one pre-registered study, and an internal meta-analysis, we tested these hypotheses against each other and found strong support for the primarily purity hypothesis. In both Dutch and American samples, we find that disgust sensitivity is more strongly related to moral judgments of purity transgressions than to moral judgments of transgressions of any other domain. No convincing support was found for the equal strength or primarily binding hypothesis.

These findings are in line with Moral Foundations Theory, which argues that differences in moral sensitivity to each domain can be dependent on an individual's personality (Graham et al., 2013). The general idea is that specific personality traits make specific problems in our surroundings salient, and over time, these types of problems become the focus of our moral concern. In our case, the personality trait of disgust sensitivity seems to make an individual especially concerned with transgressions of moral purity.

A Permissive Equal Strengths Hypothesis

Although these findings are not supportive of the equal strength hypothesis as we defined it, we should note that not everyone might agree with the strict perspective we took of this account. A more permissive version of this hypothesis might predict that disgust sensitivity does not relate to one moral domain specifically and so correlations might be found with other domains, no matter their strength. Without the restriction that all moral domains have an equally strong relationship with disgust sensitivity,

this account would receive more support. For example, one could point to the significant correlations between disgust sensitivity and moral judgments of the care and authority domain in Study 2.5 and interpret these as evidence in favor of this permissive version of the equal strength hypothesis. However, we believe that such an account has two major drawbacks. First, this version of the equal strengths hypothesis has very little predictive power. It does not identify which moral domains should or should not correlate with certain personality characteristics and it does not specify a sufficiently strong correlation to "count" as evidence in support of the hypothesis. For example, if we found a significant correlation between disgust sensitivity and non-purity judgments that was a very small $r = .05$, would that be consistent with an equal strengths hypothesis? This seems too permissive to be useful. Second, even when putting aside this shortcoming, the evidence for such an account is, according to our data, weak at best. Although we identified some significant correlations between non-purity domains and disgust sensitivity in our studies, they do not appear consistently across all of our studies. For example, disgust sensitivity is not significantly related to moral judgments in the authority domain in Studies 2.1, 2.2, and 2.3, nor to the moral judgments of the care domain in Studies 2.1 and 2.2. We therefore conclude that, even when taking into account a more permissive version of the equal strength hypothesis, our data fit the primarily purity hypothesis best.

Moral Foundations Vignettes vs. Moral Foundations Questionnaire

Certainly, we are not the only ones to have proposed and tested such a link between disgust and moral purity (e.g., Crawford et al., 2014; Horberg et al., 2009; Inbar, Pizarro, & Bloom, 2009; Inbar, Pizarro, Knobe et al., 2009; Jarudi, 2009; Olatunji, 2008; Rozin, Lowery et al., 1999; Smith et al., 2011). Recently, van Leeuwen and colleagues (2017) demonstrated that trait pathogen disgust is related to moral purity measured by the Moral Foundations Questionnaire

(MFQ). While their research might look similar at face value, we think that there are some important distinctions that should be highlighted. One distinction is that the MFQ and the Moral Foundations Vignettes (MFV), used in our studies, measure distinct components of morality. While the MFQ focuses on the relevance of abstract moral concerns, the MFV is set up to test moral judgments of specific behaviors and situations. Moral judgments, as compared to measures of abstract moral concerns, are important outcomes because they allow for the impact of moral intuitions and form the basis of one of the criteria determining the existence of a moral domain (see Introduction). Even though the second half of the MFQ are said to include moral judgment items, it can be doubted to what degree these actually assess moral condemnation (i.e., disagreeing with items such as "I am proud of my country's history" does not necessarily imply that the participant thinks it is morally wrong to be proud of your country's history) and most items still focus on endorsement of abstract situations or values (e.g., "I would call some acts wrong on the grounds that they are unnatural"). Although it is likely that such broad moral concerns inform moral judgments of specific situations, Graham and colleagues (2009, p. 1031) agree that the MFQ "does not necessarily measure how people actually make moral judgments". Importantly, correlations between the MFV and MFQ are indeed small to medium, which is not surprising since studies show that people express different degrees of moral concern depending on situation specific characteristics (e.g., Crimston, Bain, Hornsey, & Bastian, 2016; Cushman, Young, & Hauser, 2006). We believe that the most crucial contribution of our research, though, concerns disgust sensitivity's relative relation to each of the moral domains. Although previous studies have shown a link between disgust sensitivity and the purity domain, none of these have systematically compared the strength of disgust sensitivity's relation across each of the moral domains.

Possible Mechanisms

Although our data reveal overwhelming support for the primarily purity hypothesis, it remains to be tested what psychological mechanism accounts for this relation.

Behavioral Immune System. One potential mechanism that has been suggested is the close involvement of the behavioral immune system in the experience of both pathogen disgust and moral transgressions of the purity domain (Inbar & Pizarro, 2014). Purity transgressions often include potential contagion threats (e.g., via unusual foods or sexual practices)[7] to which more disgust sensitive people are more likely to respond with rejection and avoidance (Inbar & Pizarro, 2014).

A similar, but less generous explanation results from an ongoing debate on what exactly constitutes the purity domain. More specifically, it has been argued that disgust sensitivity's unique relation with purity judgments is not related to moral content, but instead is caused by general features of purity scenarios, such as direct references to core disgust elicitors (e.g., Cameron et al., 2015). However, we have two reasons to believe that such an explanation cannot account for the effects found in our studies. First, the moral transgressions that were used in our studies do not make direct references to core disgust eliciting stimuli such as bodily fluids). Second, even if this would be the case, in two additional studies we find that the presence of a core disgust elicitor in a moral transgression is not sufficient to establish a strong connection to disgust sensitivity. In these studies, including a student sample (N = 144) and a sample from the general population (N = 190), we tested

[7] Please note that the Disgust Sensitivity Scale – Revised (DS-R) includes only 1 item referring to sex. Removing this item from the DS-R did not affect any of the model comparisons reported in our studies. Similarly, the DS-R relates as strongly to purity transgressions referring to sexual activities (6 items) as to purity transgressions without such a reference (4 items; both *r*'s are .39). Conducting the analyses without these 6 items did not affect any of the model comparisons reported in Study 2.5.

whether adding a pathogen cue to non-purity moral transgressions results in a stronger relationship with disgust sensitivity (e.g., a burglar dropping ink on the carpet vs a burglar urinating on the carpet). However, disgust sensitivity does not relate to any of the moral judgments in our studies, regardless of the presence of pathogen cues (for all main effects of disgust sensitivity and all interactions between disgust sensitivity and condition, *t*'s < 1.34, *p*'s > .18). On the contrary, examining the data using Bayesian analyses (in which the fit of the data under the alternative hypothesis is compared to the fit of the data under the null hypothesis; Morey & Rouder, 2014) returned a Bayes factor of, on average, 0.425 (ranging between 0.293 and 0.712) in favor of the null hypothesis. In other words, our data were almost 2.5 times more likely to occur under the model that predicts no interaction effect of disgust sensitivity and the presence (vs. absence) of a pathogen cue on moral judgments than under the model predicting such an interaction effect (for more information on these studies, see Supplemental Materials). We therefore think it is unlikely that the potential presence of core disgust elicitors in purity transgressions alone accounts for the relationship between disgust sensitivity and purity moral judgments.

Weird Scenarios. An alternative mechanism that might be at play concerns the weirdness of moral scenarios often featured in the purity domain. Popular scenarios tapping into the purity domain are perceived to be weirder (i.e., more abnormal) than scenarios measuring the care domain (Chakroff & Young, 2015a; Gray & Keeney, 2015). According to Gray and Keeney (2015) this "weirdness may also help account for the oft-discussed link between disgust and impurity [..], without referencing distinct moral mechanisms". Although there is yet no empirical evidence supporting this claim, it could be that individuals who are more easily disgusted are more sensitive to any kind of deviation from what is normal, and thus also to these weird or bizarre scenarios representing the purity domain. As one preliminary test of this idea, we included an abstract measure of sensitivity to deviation (Okimoto & Gromet, 2016) in

Study 2.4. However, this measure was not correlated with disgust sensitivity (r[148] = -.05, p = .58) or purity moral judgments (r[148] = -.08, p = .32).

Moral Character. A related fourth potential mechanism is moral character. Recent evidence suggests that disgust is sensitive to evidence of a person's moral character (Giner-Sorrola & Chapman, 2016). People might be especially likely to use actions that are particularly abnormal, as Gray and Keeney (2015) argue purity transgressions are, as indicators of a person's moral character (Tannenbaum, Uhlmann, & Diermeier, 2011). If disgust sensitivity also indexes an interest and sensitivity to moral character, this may also help to explain the primarily purity hypothesis.

Disgust Sensitivity Measure

One potential limitation of our studies is that we use the same scale to measure disgust sensitivity in all five of our studies (i.e., DS-R; Haidt et al., 1994, modified by Olatunji, Williams et al. 2007). Although this is the most widely used measure of disgust sensitivity, some might argue it is based on an incomplete definition of disgust. The Three Domain Disgust Scale (TDDS; Tybur et al., 2009), for example, includes not only pathogen disgust, but also sexual and moral disgust. However, because the TDDS is highly correlated with all subscales of the DS-R (Tybur et al., 2009) it is likely that using this measure of disgust sensitivity would yield results similar to our current findings. In line with that reasoning, Van Leeuwen and colleagues (2017) find that the pathogen subscale of the TDDS has a high correlation with moral values of purity (r = .31), relative to correlations with moral values of authority (r = .24), loyalty (r = .19), care (r = .20), and fairness (r = .12). In addition, there is substantial overlap between the two additional subscales of the TDDS (i.e., sexual disgust and moral disgust) and specific moral domains. While the sexual disgust scale relates closely to moral transgressions in the purity domain (i.e., including items related to promiscuity and specific sexual acts), the moral disgust subscale is compatible with

moral transgressions of fairness and care (i.e., including items related to theft and dishonesty). It is therefore not surprising, and consistent with our findings, that the pathogen disgust subscale is strongly correlated with the sexual disgust subscale (i.e., purity transgressions; r = .38; Tybur et al., 2009, Study 4) and less so with the moral disgust subscale (i.e., fairness and care transgressions; r = .17; Tybur et al., 2009, Study 4).

Are Moral Domains Distinct Constructs?

Lastly, we want to address the discussion on whether the moral domains suggested by Moral Foundations Theory measure distinct constructs (e.g., Gray, Waytz, & Young, 2012). Contra Moral Foundations Theory, some have argued that the moral foundations are not distinct domains and instead are all manifestations of a single underlying domain (e.g., typically harm; Gray Young et al., 2012; Cameron et al., 2015). Although our paper aimed to distinguish between hypotheses about the association between disgust sensitivity and moral judgments across domains, our question and its answers have implications for this broader debate. For example, one could point to the relatively high correlations between moral domains in some of our studies (see especially Study 2.5, see Table 2.2) and use this to argue that all moral judgments stem from a single domain. However, these correlations – and even if they were stronger – would not provide reliable evidence in favor of the existence of one common construct.

There are several reasons. First, these high correlations were not a feature of every study, suggesting that a single domain account cannot parsimoniously describe the pattern of correlations across all of our studies. Second, prior validity testing and factor analyses by Clifford and colleagues (2015) has shown that all transgressions are reflective of distinct moral concerns. Third, and conceptually more consequential, even if scales are highly correlated that does not preclude that the scales measure different constructs. The idea that all moral domains can be reduced to one underlying construct implies

that these scales are highly correlated because they share a common latent variable that causes participants' responses on the scales. Such a model assumes that the scales share common causes, consequences, and correlates. If scales have different causes, consequences, and correlates then they do not share the same latent variable (see also statistical vs. causal uni-dimensionality, Markus & Borsboom, 2013, p. 148-149). Research on attitude strength illustrates this idea very clearly. While some indicators of attitude strength are highly correlated, there is robust evidence that they have unique causes and correlates, therefore demonstrating that they are unique (but correlated) constructs (e.g., Krosnick, Boninger, Chuang, Berent, & Carnot, 1993; Visser, Bizer, & Krosnick, 2006). If the different moral domains would actually measure only one construct, all domains should have common correlates and the results should have favored the equal strength hypothesis. However, our studies did not favor this hypothesis. Instead, our studies consistently found a stronger relationship between disgust sensitivity and the purity domain. This finding in itself is an argument against the claim that these domains are all based on a common construct.

Conclusion

A key task for understanding taxonomies of the moral domain is how judgments in these different domains are similar and different. One area where some scholars expect differences and where others claim similarities are the traits and emotions that are linked with judgments across the moral domains. By purposefully investigating disgust sensitivity as it relates to several moral domains, our data add and speak to this broader debate. We find that although making moral judgments is an emotional process, the tendency to feel disgust is not consistently related to types of moral judgments. Instead, as suggested by domain-centric theories like Moral Foundations Theory, disgust sensitivity is primarily associated with moral judgments in the purity domain.

3

Disgust sensitivity and moral judgments of purity: The role of transgression weirdness

Based on: Wagemans, F. M. A., Brandt, M. J., & Zeelenberg, M. (2017). Disgust sensitivity and moral judgments of purity: The role of transgression weirdness. Retrieved from https://psyarxiv.com/c5h42

Chapter 3

Abstract

Disgust sensitivity is more strongly related to moral judgments in the purity domain than to moral judgments in other moral domains. While this finding highlights the distinctiveness of moral domains, anti-modularity accounts suggest that the relationship is caused by the relative weirdness of purity transgressions and come to the conclusion that moral domains do not represent distinct mechanisms. In two studies (total $N = 2{,}307$), we test whether transgression weirdness accounts for disgust sensitivity's stronger association with moral judgments of the purity as compared to other moral domains, but find little evidence for this claim. The relationship between disgust sensitivity and moral judgments of purity even remains when taking into account both (perceived) weirdness and (perceived) harmfulness of moral transgressions. These studies show that transgression weirdness and harmfulness cannot explain the disgust sensitivity–purity link, contradicting predictions following from popular anti-modularity accounts.

Are moral domains distinct entities? Some perspectives argue for distinct moral domains with different causes and consequences (modularity accounts; e.g., Graham et al., 2013), whereas other perspectives argue for a single moral domain associated with perceived harm (anti-modularity accounts; e.g., Schein & Gray, in press). One relevant finding to this debate is the consistently stronger relationship between trait disgust sensitivity and moral judgments of purity transgressions compared to moral judgments of transgressions of other types of moral domains (Horberg et al., 2009; Wagemans, Brandt, & Zeelenberg, 2018). The advocates for modularity accounts interpret this finding as evidence for the distinctiveness of moral domains (Graham et al., in press) because it highlights that purity moral judgments have a distinct predictor. However, this distinct relationship might not be caused by differences in moral content per se, but by other characteristics of purity transgressions. More specifically, some propose that a sampling bias of the moral domain has resulted in purity transgressions that are substantially weirder than other types of moral transgressions (Gray & Keeney, 2015), which might explain the stronger relationship between disgust sensitivity and moral judgments of purity versus other moral domains. We test this hypothesis.

The Debate

A substantial number of studies have demonstrated that those scoring higher on trait disgust sensitivity show enhanced moral condemnation of issues such as abortion, non-traditional sexual practices, gay marriage, and homosexuality in general (Crawford et al., 2014; Inbar, Pizarro, & Bloom, 2009; Inbar, Pizarro, Knobe et al., 2009; Jarudi, 2009; Olatunji, 2008; Smith et al., 2011). The association appears to be domain-specific: Disgust sensitivity has a consistently stronger relationship with moral judgments of purity issues than with moral judgments of any other moral domain, including care, fairness, authority, loyalty, and liberty domains (Horberg et al., 2009; Wagemans et al., 2018).

The consistently stronger association between disgust sensitivity and purity judgments provides evidence for the distinctiveness of moral domains as proposed by theories advocating moral modularity, such as Moral Foundations Theory (Graham et al., in press; Horberg et al., 2009). Importantly, these modularity accounts are based on the notion that moral domains are meaningfully distinct categories that each have their own psychological processes and causal factors, such as personality characteristics that make individuals more sensitive to a specific moral domain (Graham et al., 2013). For the moral domain of purity this appears to be disgust sensitivity. The idea is that disgust developed from a purely disease avoidance emotion to an emotion that is also triggered by perceptions of immorality (Curtis & Biran 2001; Rozin et al., 2000; Tybur et al., 2013). The joint association between disgust and the purity domain specifically likely results from the shared pathogen avoidance process thought to underpin the evolutionary origins of both feelings of disgust and moral purity (Haidt, 2012; Inbar & Pizarro, 2014).

It is possible, however, to interpret the link between disgust sensitivity and purity judgments from another perspective. That is, the link between disgust sensitivity and purity judgments might result from a sampling bias of the moral domain (Chakroff & Young, 2015a; Gray & Keeney, 2015). The idea here is that a bias in the selection of purity transgressions resulted in scenarios that are substantially weirder than scenarios representing other moral domains. In line with this reasoning, Gray and Keeney (2015) show that classic purity transgressions (e.g., “someone cooks and eats their dog, after it dies of natural causes”) are perceived to be weirder than transgressions of the care domain (e.g., “someone kicks a dog in the head, hard”; Graham et al., 2009). Both are immoral, both involve dogs, but one is perceived to be considerable weirder.

This finding is interpreted as being consistent with anti-modularity accounts because it suggests that weirdness, and not some distinct moral mechanism, might be responsible for the disgust

sensitivity–purity link. It is possible that both disgust sensitivity and moral judgments of purity are tapping into a general sensitivity towards weird or bizarre situations, and that scenario weirdness therefore accounts for the stronger association between disgust sensitivity and moral judgments of purity transgressions. If this hypothesis is supported, it would challenge not only the existence of a purity domain that is meaningfully distinguishable from other moral domains, but it would also question the validity of Moral Foundations Theory, one of the most prominent theories in moral psychology.

The Current Studies

Despite the theoretical importance of the weirdness confound, there is no satisfactory empirical study testing the possibility. Other studies have examined weirdness and disgust (Schein, Ritter, & Gray, 2016; Study 3), but they did not test if weirdness accounts for the differential relationships across domains. That is, they did not account for the finding that most clearly separates the modularity accounts from the anti-modularity accounts. In the current paper, we will directly test whether transgression weirdness can explain the stronger relationship between disgust sensitivity and moral judgments of the purity domain compared to other moral domains.

Study 3.1

We first test whether we replicate the finding that purity transgressions are perceived to be weirder than transgressions from other moral domains. Next, we test whether this weirdness moderates the relationship between disgust sensitivity and moral judgments over and above the moderating effect of moral domain, such that disgust sensitivity has a stronger relationship to moral judgments of transgressions that are perceived to be weirder. For this, we ask one sample of participants to rate how weird they find a number of

standardized moral judgments (Clifford et al., 2015) and combine these weirdness ratings with published (Wagemans et al., 2018) and unpublished existing datasets on the relationship between disgust sensitivity and moral judgments[8]. In addition, we control for transgression harmfulness because it is suggested as an important factor underlying moral judgments (Gray & Schein, 2012).

Method

We aggregated data from studies that include a measure of disgust sensitivity and moral judgments from the Moral Foundations Vignettes (Clifford et al., 2015). We chose this set of moral judgments as it is a well-validated and standardized set of moral judgments based on Moral Foundations Theory (see Clifford et al., 2015 for a description of the validation process), which includes moral transgressions of six moral domains: Purity, care, authority, fairness, loyalty, and liberty. In order to make comparisons between moral domains, datasets were only included when they measured moral judgments of the purity domain and at least one other moral domain. Because none of the existing datasets included measures of transgression weirdness or transgression harmfulness, a new sample was collected to measure these aspects. The existing and new datasets were then combined by matching moral transgressions in the existing datasets with the average weirdness and harmfulness score per moral transgression from the new dataset.

New Data Participants. To get reliable estimates of a transgression's weirdness and harmfulness, we aimed to collect ratings of at least 75 participants for each rating type. In the end, 151 participants were recruited via Amazon's Mechanical Turk (78 males, 73 females, M_{age} = 34.30, SD = 10.37) and completed our study in return for a financial reward.

[8] The exact materials that were used in all studies and the relevant datasets can be found in the supplemental materials at the Open Science Framework (OSF; Supplemental Materials via https://goo.gl/9SBYYn).

New Data Materials. Moral transgressions were taken from the Moral Foundations Vignettes (Clifford et al., 2015). A total of 60 transgressions were used; ten from each moral domain (i.e., purity, care, authority, fairness, loyalty, and liberty). Example items are "You see an employee at a morgue eating his pepperoni pizza off of a dead body" (purity domain) and "You see a woman spanking her child with a spatula for getting bad grades in school" (care domain). To allow matching of the new dataset with the existing datasets, the moral transgressions used in this new study include all moral transgressions that were used in the existing datasets.

Participants were randomly assigned to rate the weirdness or the harmfulness of moral transgressions. Depending on the task, participants indicated for each moral transgression how weird (i.e., unusual, bizarre, odd) they found the situation on a scale ranging from 1 = 'Not at all weird' to 7 = 'Extremely weird', or how harmful they found the situation on a scale ranging from 1 = 'Not at all harmful' to 7 = 'Extremely harmful'. Intraclass correlation coefficients (ICC) for these sets were calculated using the "icc" function in the "irr" package of R (Gamer, Lemon, Fellows, & Sing, 2012). The model was set to be "twoway" and the type of ICC was set to "consistency". ICC's for, respectively, weirdness and harmfulness ratings were .37 (95% CI [0.30, 0.47]) and .19 (95% CI [0.14, 0.26]). All moral transgressions were presented in a random order to each participant.

Existing Datasets. The new data was combined with six published datasets (Wagemans et al., 2018) and three unpublished datasets from our lab (total N = 2,008).[9] As described above, in each dataset, moral judgments were measured with items from the Moral Foundations Vignettes (Clifford et al., 2015), but the number of items and moral domains measured differs per dataset (see Table 3.1). In seven of the datasets, disgust sensitivity was measured with the 27-item Disgust Sensitivity Scale-Revised (DS-R; Haidt et al., 1994, modified by Olatunji, Williams et al., 2007), in one dataset with the

[9] These are the same three datasets as used in Study 4.1.

30-item London Disgust Scale (Curtis, 2013), and in one dataset with the 21-item Three Domain Disgust Scale (Tybur et al., 2009). This last disgust sensitivity scale has three subscales; pathogen, sexual, and moral disgust. For our study, we excluded the moral disgust subscale because this subscale likely has a different relationship with purity transgressions than the pathogen and sexual disgust subscales, as the items in the scale are conceptually close to moral transgressions of fairness and care. The other two subscales, pathogen and sexual disgust, were combined into one disgust sensitivity variable. An overview of the datasets and the materials that were used in each dataset can be found in Table 3.1.

Results

Data Analytic Strategy. All samples were analyzed together. Linear mixed-effects models were used to estimate the effects of disgust sensitivity, moral domain, weirdness, and harmfulness on moral judgments while taking into account random variance (and nesting) of participants, moral transgressions, and samples. The analyses were conducted using the "lmer" function in the "lme4" package of R (Bates, Mächler, Bolker, & Walker, 2015). The "lmerTest" package was used to obtain *p*-values for regression coefficients (Kuznetsova, Brockhoff, & Christensen, 2013) and the "confint" function in the "stats" package was used to obtain confidence intervals for all effects using Monte Carlo simulations (drawing 1000 bootstrap samples; R Core Team, 2017). Because not all disgust sensitivity scales were measured on the same response scale, disgust sensitivity scores were mean centered and standardized within each dataset (generating z-scores using the "scale" function in the "base" package of R; R Core Team,2017). To improve comparability of predictors, also transgression weirdness and transgression harmfulness ratings were mean centered and standardized by generating z-scores.

Table 3.1

Overview of existing datasets and their materials used in Study 3.1.

Sample	***N***	**DS scale** (α)	**Purity** No. of items (α)	**Care** No. of items (α)	**Fairness** No. of items (α)	**Authority** No. of items (α)	**Loyalty** No. of items (α)	**Liberty** No. of items (α)
Dataset 3.1	80	DS-R (.85)	2 (.20$_a$)	2 (.13$_a$)	2 (.18$_a$)	2 (.42$_a$)		
Dataset 3.2	221	DS-R (.88)	3 (.63)	3 (.43)	2 (.25$_a$)	2 (.44$_a$)		
Dataset 3.3	204	DS-R (.84)	3 (.63)	3 (.57)	2 (.47 $_a$)	2 (.30$_a$)		
Dataset 3.4	148	DS-R (.84)	4 (.63)	2 (.08$_a$)	2 (.25$_a$)			
Dataset 3.5	451	DS-R (.87)	10 (.91)	10 (.90)	10 (.90)	10 (.92)	10 (.92)	10 (.90)
Dataset 3.6	304	DS-R (.89)$_b$	10 (.93)	10 (.91)	10 (.90)	10 (.94)	10 (.94)	10 (.91)
Dataset 3.7	201	DS-R (.92)	10 (.90)	10 (.90)				

Table 3.1 (continued)

Samples	***N***	**DS scale** (α)	**Purity** No. of items (α)	**Care** No. of items (α)	**Fairness** No. of items (α)	**Authority** No. of items (α)	**Loyalty** No. of items (α)	**Liberty** No. of items (α)
Dataset 3.8	199	LD (.94)	10 (.87)	10 (.91)				
Dataset 3.9	200	TDD (.88)	10 (.87)	10 (.90)				

Note: DS-R = Disgust Sensitivity Scale – Revised; LD = London Disgust Scale; TDD = Three Domain Disgust Scale (pathogen and sexual subscales). Table includes the disgust sensitivity scale (DS) used, the number of moral judgments per domain, and reliabilities (α) of all scales per sample. Reliability estimates with an [a] indicate correlations. [b] In this dataset, seven DS-R items were accidentally excluded. Analyses were conducted with the 19 remaining items.

Before testing the moderating effect of transgression weirdness, we tested whether purity transgressions are indeed perceived to be weirder than transgressions of other moral domains. Replicating Gray and Keeney (2015), we found that purity transgressions are perceived to be significantly weirder (M = 5.90, SD = 1.56) than transgressions of all other moral domains (all means < 4.73, SD's < 1.93, absolute values of all t's > 3.88, p's < .001; see Supplemental Materials).[10]

Moral Domain and Weirdness as Moderators. Prior work found that disgust sensitivity is more strongly associated with moral judgments in the purity domain compared to other moral domains. To re-test this, we used disgust sensitivity, moral domain (0 = non-purity, 1 = purity), and their interaction to predict moral judgments. There was a significant main effect of disgust sensitivity (b = 0.32, SE = 0.01, t[49360] = 34.44, p < .001, 95% CI [0.30, 0.34]) and moral domain (b = 0.86, SE = 0.29, t[59] = 2.98, p = .004, 95% CI [0.29, 1.42]). Replicating past work, there was a significant interaction between disgust sensitivity and moral domain (b = 0.28, SE = 0.02, t[24077] = 16.24, p < .001, 95% CI [0.25, 0.31]), indicating a stronger association between disgust sensitivity and moral judgments of purity as compared to non-purity domains (see Figure 3.1, left panel).[11]

To test if transgression weirdness accounts for this interaction, we tested a second model in which transgression

[10] Purity transgressions were perceived to be equally harmful as transgressions of the care, fairness, and liberty domains (absolute values of all t's < 0.58, p's > .56), but were perceived as significantly more harmful than transgressions of the authority and loyalty domains (absolute values of both t's > 3.49, p's < .001; see Supplemental Materials).

[11] Much of this data was previously published (Wagemans et al., 2018) and found the same results. This analysis merely shows that the effect still holds after including new data using various measures of disgust sensitivity and with a different (but conceptually similar) data analytic strategy, chosen to more easily incorporate weirdness.

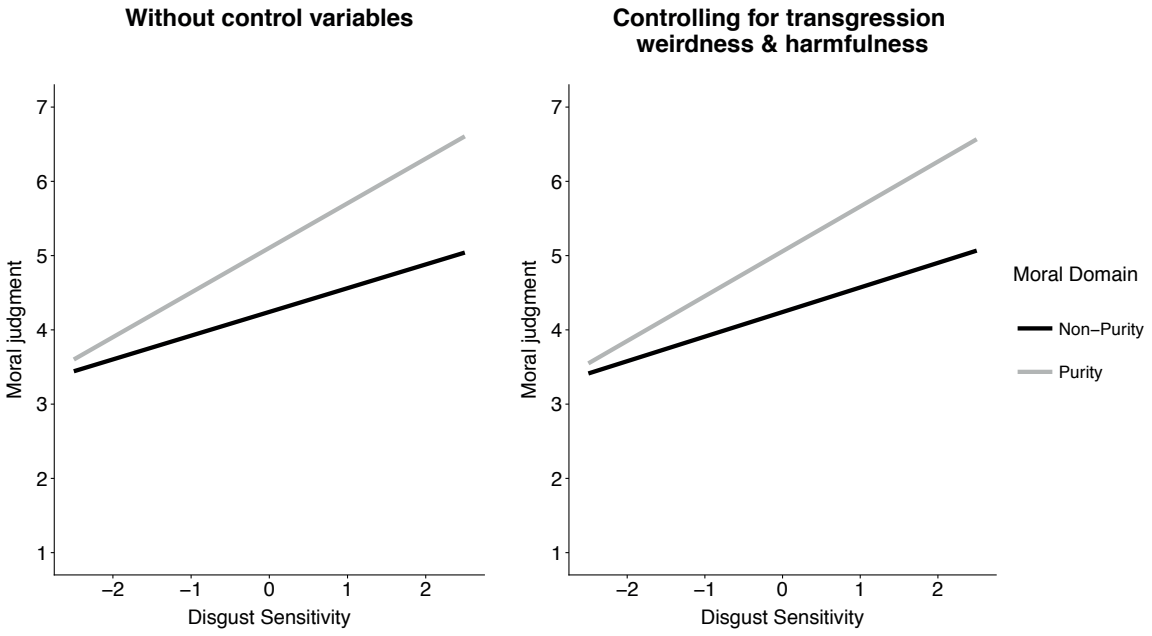


Figure 3.1. The interaction effect of disgust sensitivity (standardized) and moral domain (purity vs non-purity transgressions) on moral judgments (Study 3.1). The left panel is the initial disgust sensitivity moral domain interaction (b = 0.28, SE = 0.02, p < .001). The right panel is the disgust sensitivity moral domain interaction controlling for transgression weirdness, transgression harmfulness, and interactions between these variables and disgust sensitivity (b = 0.27, SE = 0.03, p < .001).

weirdness and its interaction with disgust sensitivity were added. There was no main effect of transgression weirdness (b = -0.06, SE = 0.15, t[57] = -0.36, p = .72, 95% CI [-0.38, 0.25]) and also the interaction between disgust sensitivity and transgression weirdness was not significant (b = -0.01, SE = 0.01, t[3890] = -0.90, p = .37, 95% CI [-0.03, 0.01]). The interaction between disgust sensitivity and moral domain, however, remained (b = 0.30, SE = 0.03, t[8666] = 11.74, p < .001, 95% CI [0.25, 0.34]), showing that transgression weirdness cannot account for the domain-specific relationship between disgust sensitivity and moral judgments of purity.

Finally, we tested whether controlling for transgression harmfulness and its interaction with disgust sensitivity affects our findings by adding these terms to a third model. While there was a

main effect of transgression harmfulness (b = 0.72, SE = 0.06, t[60] = 11.98, p < .001,95% CI [0.60, 0.84]) and a significant interaction effect of disgust sensitivity and transgression harmfulness (b = -0.07, SE = 0.01, t[11030] = -8.47, p < .001, 95% CI [-0.08, -0.05]), the interaction between disgust sensitivity and moral domain still remained (b = 0.27, SE = 0.03, t[8601] = 10.66, p < .001, 95% CI [0.22, 0.32]; see Figure 3.1, right panel). We replicated and reproduced prior work and showed that neither weirdness nor harmfulness of a moral transgression can account for the domain-specific relationship between disgust sensitivity and moral judgments of purity. Notably, the effect size of the interaction between disgust sensitivity and moral domain barely changed across models. This can be seen by comparing the remarkably similar panels in Figure 3.1.

Discussion

In the first study, we tested whether transgression weirdness can account for the moderating effect of moral domain on the relationship between disgust sensitivity and moral judgments. It cannot.

The methods of the first study made it possible to test the influence of weirdness in a large sample, but it also has a shortcoming. We calculated average weirdness scores for each moral transgression and subsequently matched these scores with existing data on the relationship between disgust sensitivity and moral judgments. While this set-up assumes transgression weirdness to be a constant factor across participants, this assumption might be faulty. For instance, the relatively low intraclass correlation coefficients of transgression weirdness and transgression harmfulness found in Study 3.1 suggest that individuals do not fully agree on what is or is not weird. It is possible that more disgust sensitive individuals judge moral transgressions of the purity domain to be more immoral because they perceive them to be more deviant from what is normal (i.e., weird). The idea is that weirdness mediates the relationship between disgust sensitivity and moral judgments of the purity

domain, such that more disgust sensitive people perceive purity transgressions to be weirder than less disgust sensitive people and, as a result, judge these transgressions as more immoral. In Study 3.2, we tested this mediation hypothesis by obtaining disgust sensitivity scores and ratings of immorality and weirdness all from the same participants. We also tested the potential of perceived harmfulness as a mediator in our model (cf. Schein et al., 2016).

Study 3.2

Method

Participants. Students could participate in our lab study for one week (usually yielding between 100 and 150 participants). In the end, 148 Dutch students (33 males, 115 females, M_{age} = 20.16, SD = 2.85) participated in our study in return for course credit. Because a power analysis for our multilevel mediation model would likely be inaccurate as it requires a priori information of various unknown factors (e.g., intra-class correlation coefficients and estimations of multiple path coefficients), we used two rough estimations of power. First, using G*Power (Faul et al., 2007), we calculated the size of the difference in slopes (i.e., difference between disgust sensitivity's relationship to moral judgments of the purity and non-purity domains) this sample allows us to detect given 80% power. This resulted in a difference in slopes of .232 and higher. As a second estimation of power, we used Preacher, Rucker, and Hayes' (2007) power estimates for single-level moderated mediation analysis, which shows that a sample size of 100 is sufficient to detect medium effects with close to 95% power.

Materials. To help avoid consistency effects, our study was divided into two parts that were separated by an unrelated study on attitudes towards social groups. In the first part of our study, participants rated a total of 48 moral transgressions that were taken from the same set of moral transgressions as in Study 3.1 (i.e., Moral Foundations Vignettes; Clifford et al., 2015). These 48 moral

transgressions were equally divided over six moral domains: Purity, care, authority, fairness, loyalty, and liberty. For each transgression, participants used three items to indicate to what degree they found the situation immoral ("I find this immoral"), weird ("I find this weird [unusual, bizarre, odd]"), and harmful ("I find this harmful") on a scale ranging from 1 = 'Not at all" to 7 = 'Very much". All moral transgressions were presented in a random order to each participant.

Participants then participated in the unrelated study before continuing with the second part of our study in which participants filled out the 27-item Disgust Sensitivity Scale revised (Haidt et al., 1994; modified by Olatunji, Williams et al., 2007; α = .85). This is the same disgust sensitivity scale used in many of the samples in Study 3.1. The first 14 items are answered on a 5-point scale ranging from 1 = 'Strongly disagree (very untrue about me)' to 5 = 'Strongly agree (very true about me)'. An example item is "It bothers me to hear someone clear a throat full of mucus". The remaining 13 items are answered on a 5-point scale ranging from 1 = 'Not disgusting at all' to 5 = 'Extremely disgusting'. An example item is "While you are walking through a tunnel under a railroad track, you smell urine". The scale includes two filler items that are excluded from all analyses.

Results

Data Analytic Strategy. As in Study 3.1, linear mixed-effects models were used to estimate the effects of disgust sensitivity, moral domain, perceived weirdness, and perceived harmfulness on moral judgments while taking into account random variance (and nesting) of participants and moral transgressions. Regression coefficients, *p*-values, and confidence intervals were obtained in the same manner as in Study 3.1. Following recommendations by Zhang, Zyphur, and Preacher (2009), disgust sensitivity (i.e., Level-2 predictor) was grand-mean centered by subtracting the overall mean from each individual's disgust sensitivity score, while perceived weirdness and harmfulness (i.e., Level-1 predictors) were cluster-mean centered by subtracting each individual's mean weirdness or harmfulness score

from the weirdness or harmfulness ratings. Each individual's mean weirdness or harmfulness score (i.e., Level-2 predictors) was grand-mean centered by subtracting the overall weirdness or harmfulness mean from each individual's mean weirdness or harmfulness score. All models using perceived weirdness and/or harmfulness as predictors include both the Level 1 and Level 2 versions of the variables, but only the effects of the Level 2 variables are reported as these are relevant to our predictions (also see Zhang et al., 2009; see Supplemental Materials for full model results). To test for multilevel moderated multiple mediation in a 2-1-1 model, we followed the steps described by Zhang and colleagues (2009) for multilevel mediation and, following the hypotheses, test the moderating effect of moral domain in steps 1 and 2.

Step 1. Disgust Sensitivity and Moral Judgments. First, we tested whether disgust sensitivity is a predictor of moral judgments. A positive relationship was found ($b = 0.27$, $SE = 0.08$, $t(146) = 3.35$, $p = .001$, 95% CI [0.10, 0.42]), showing that higher scores on disgust sensitivity are associated with harsher moral judgments across domains. To test for the moderating effect of moral domain, the model was extended with moral domain (non-purity = 0, purity = 1) and its interaction with disgust sensitivity as predictors. In line with Study 3.1 and previous findings (Wagemans et al., 2018), moral domain moderated the effect of disgust sensitivity on moral judgments ($b = 0.71$, $SE = 0.13$, $t(146) = 5.44$, $p < .001$, 95% CI [0.45, 0.95]), such that disgust sensitivity was more strongly related to moral judgments of purity ($b = 0.86$, $SE = 0.14$, $t(146) = 6.10$, $p < .001$, 95% CI [0.61, 1.14]) than to moral judgments of non-purity domains ($b = 0.15$, $SE = 0.08$, $t(146) = 1.87$, $p = .06$, 95% CI [-0.01, 0.33]; see Figure 3.2).

Step 2A. Disgust Sensitivity and Perceived Weirdness. We then tested whether disgust sensitivity is a predictor of the first potential mediator, perceived weirdness. A positive relationship was found ($b = 0.22$, $SE = 0.08$, $t(146) = 2.62$, $p = .01$, 95% CI [0.06, 0.39]), showing that higher disgust sensitivity scores are associated

with higher perceptions of weirdness across all moral domains. To test the potential of perceived weirdness as a mediator of the relationship between disgust sensitivity and moral judgments of the purity domain specifically, the moderating effect of moral domain was again tested by including moral domain and its interaction with disgust sensitivity in the model. No interaction effect of moral domain and disgust sensitivity on perceived weirdness was found (b = -0.02, SE = 0.11, t(189.68) = -0.22, p = .82, 95% CI [-0.21, 0.17]), showing that perceived weirdness *cannot* account for the stronger association between disgust sensitivity and moral judgments of purity transgressions as compared to moral judgments of non-purity transgressions. It is therefore no longer considered as a potential mediator of the disgust sensitivity-domain interaction effect. To be conservative, we controlled for perceived weirdness in all subsequent models with moral judgments as the outcome variable (see Figure 3.2 and the Supplemental Materials).

Step 2B. Disgust Sensitivity and Perceived Harmfulness. We then tested whether disgust sensitivity was related to the second potential mediator, perceived harmfulness. A positive relationship was found (b = 0.30, SE = 0.10, t(146) = 2.88, p = .005, 95% CI [0.08, 0.50]), showing that higher disgust sensitivity scores are associated with higher perceptions of harmfulness across all moral domains. To test whether perceived harmfulness can account for the relationship between disgust sensitivity and moral judgments of the purity domain specifically, the moderating effect of moral domain was again tested by including moral domain and its interaction with disgust sensitivity in the model. This revealed a significant interaction effect of disgust sensitivity and moral domain on perceived harmfulness (b = 0.73, SE = 0.14, t(146) = 5.03, p < .001, 95% CI [0.45, 1.01]). In line with the idea of perceived harmfulness as a mediator of the disgust sensitivity–purity link specifically, disgust sensitivity relates to perceived harmfulness of purity transgressions (b = 0.90, SE = 0.16, t(146) = 5.52, p < .001, 95% CI [0.58, 1.20]) but not to perceived harmfulness of non-purity transgressions (b = 0.18,

SE = 0.11, *t*(146) = 1.69, *p* = .09, 95% CI [-0.03, 0.38]); see Figure 3.2).

Step 3. Perceived Harmfulness and Moral Judgments. Because moral domain moderates the paths of disgust sensitivity to both moral judgments and perceived harmfulness, we further test the potential for perceived harmfulness as a mediator for each level of moral domain (purity vs non-purity) separately. A model including disgust sensitivity, perceived harmfulness, and perceived weirdness as predictors and moral judgments as the outcome variable was fitted to the data on purity transgressions and the data on non-purity transgressions. Perceived harmfulness related positively to both purity (*b* = 0.47, *SE* = 0.07, *t*(180.12) = 6.53, *p* < .001, 95% CI [0.33, 0.62]) and non-purity moral judgments (*b* = 0.31, *SE* = 0.05, *t*(144.97) = 5.86, *p* < .001, 95% CI [0.20, 0.41]), showing that transgressions that are perceived to be more harmful are also considered to be more immoral (see Figure 3.2).

Indirect and Direct Effects. Indirect and direct effects were calculated for each level of moral domain (purity vs non-purity) separately. In line with the idea of perceived harmfulness as a mediator of the disgust sensitivity–purity link specifically, perceived harmfulness did not mediate the relationship between disgust sensitivity and moral judgments for non-purity transgressions (indirect effect: 0.06, *SE* = 0.04, *z* = 1.58, *p* = .11), but it did do so for purity transgressions (indirect effect: 0.42, *SE* = 0.10, *z* = 4.31, *p* < .001). However, even when controlling for perceived weirdness and the mediating effect of perceived harmfulness, the association between disgust sensitivity and moral judgments of purity transgressions remained (*b* = 0.19, *SE* = 0.08, *t*(185.76) = 2.27, *p* = .02, 95% CI [0.03, 0.35]). Importantly, these findings mean that perceived harmfulness, together with perceived weirdness, can only account for part of the relationship between disgust sensitivity and moral judgments of the purity domain. A graphical representation of this mediation, for purity and non-purity transgressions separately, can be found in Figure 3.2.

General Discussion

Moral transgressions of purity are perceived to be weirder than moral transgressions of care (Gray & Keeney, 2015), but can this weirdness account for the stronger association between disgust sensitivity and moral judgments of purity compared to non-purity transgressions? In two studies, using a total of 2,307 participants, we tested this claim, but found little evidence.

Study 3.1 shows that transgression weirdness cannot account for the moderating effect of moral domain on the relationship between disgust sensitivity and moral judgments. In Study 3.2, we further investigate whether perceived weirdness can explain the disgust sensitivity – purity link by testing its potential as a mediator, but find no support for this idea. Together, these studies show that although purity transgressions are indeed weirder than other types of transgressions, this weirdness cannot account for the stronger association between disgust sensitivity and moral judgments of the purity domain.

While we find no evidence for perceived weirdness as an explanation of the stronger relationship between disgust sensitivity and moral judgments of the purity domain, perceived harmfulness appears to be a better candidate. This is in line with predictions following from anti-modularity accounts, such as the Theory of Dyadic Morality, stating that moral judgments of all moral domains can be reduced to perceptions of harmfulness (Gray & Schein, 2012; Schein & Gray, in press). When it comes to the disgust sensitivity-purity link, it is thought that more disgust sensitive people perceive more harm in transgressions of the purity domain compared to less disgust sensitive people, and subsequently, they show stronger moral condemnation of these transgressions. Importantly, this view of morality, in which perceived harmfulness underlies all moral judgments, also implies that there are no meaningfully distinct modules of morality, thereby

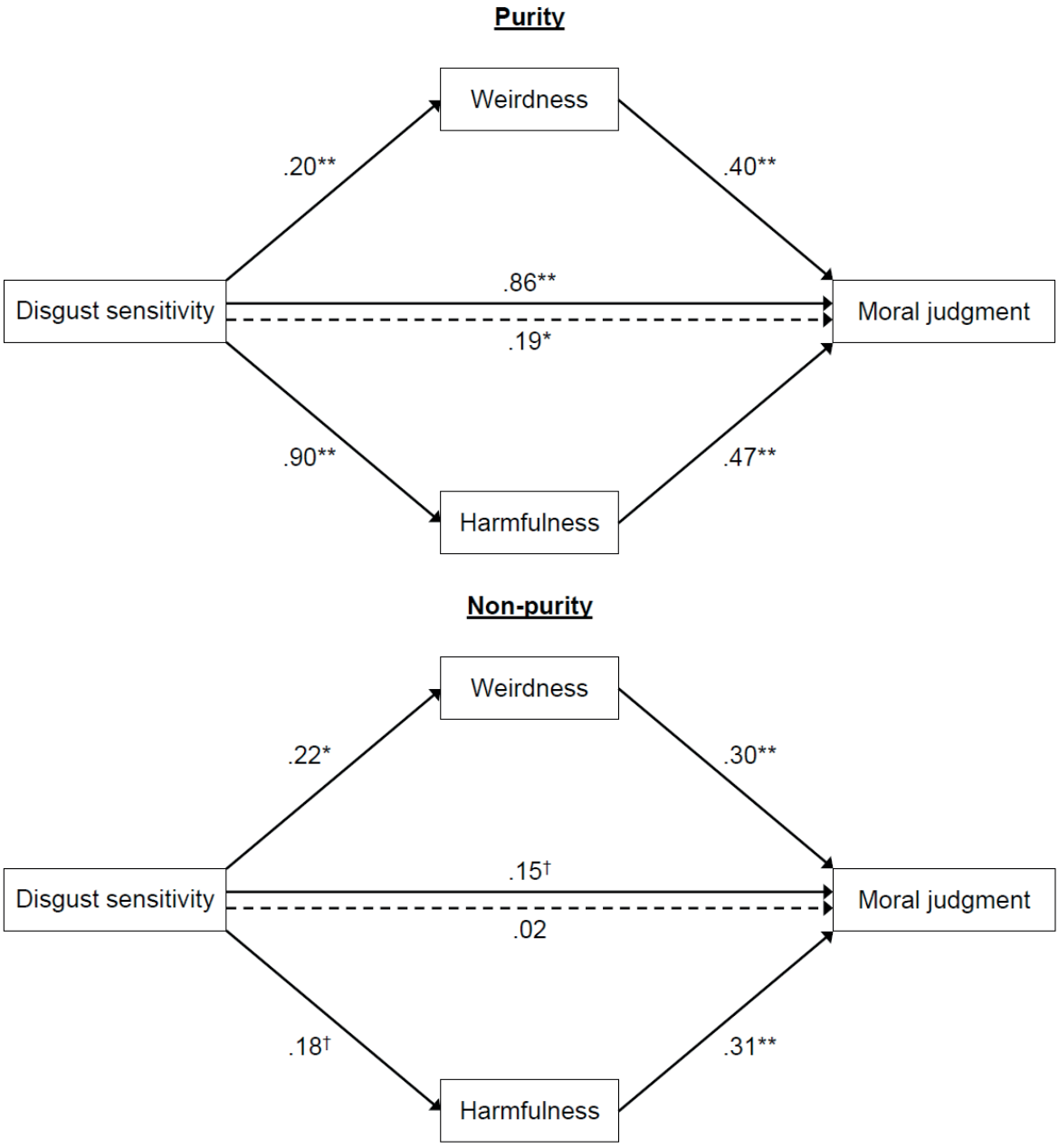


Figure 3.2. Unstandardized regression coefficients representing the effect of disgust sensitivity on moral judgments, mediated by perceived weirdness and perceived harmfulness of transgressions, for each level of moral domain (i.e., purity vs non-purity transgressions). The dashed line and its regression coefficient represent the direct effect of disgust sensitivity on moral judgments, controlling for perceived weirdness and perceived harmfulness. $^{\dagger}p < .10$, * $p < .05$, ** $p < .01$.

contradicting popular theories of moral modularity (e.g., Moral Foundations Theory).

However, we should also note that the evidence in favor of such an account is limited. If all moral judgments can be reduced to harmfulness perceptions, one would expect that perceived harmfulness fully accounts for any relationship between a personality trait and a specific moral domain. This is not what we find. Although Study 3.2 shows evidence for perceived harmfulness as a mediator of the disgust sensitivity-purity link, it accounts for only part of the variance. Even when controlling for perceived harmfulness and perceived weirdness, disgust sensitivity's direct relation to moral judgments of purity transgressions remains, suggesting that other factors play an important role in explaining the domain-specific relationship between disgust sensitivity and the purity domain. Interestingly, this means that even when two explanations suggested by anti-modularity accounts (i.e., weirdness and harmfulness) are taken into account, the moral domain of purity can be distinguished from other moral domains by its unique association to disgust sensitivity. This supports expectations following from modularity accounts of morality, such as Moral Foundations Theory.

4

Weirdness of disgust sensitivity items predicts their relationship to purity moral judgments

Based on: Wagemans, F. M. A., Brandt, M. J., & Zeelenberg, M. (in preparation). Weirdness of disgust sensitivity items predicts their relationship to purity moral judgments.

Chapter 4

Abstract

Disgust sensitivity predicts judgments of moral issues. This relationship is especially pronounced for transgressions of the purity domain, but the reason for this domain-specific relationship is unclear. One potential explanation is that measures of disgust sensitivity and purity transgressions share an important characteristic: They are weird. Here we test this "weirdness overlap" hypothesis by examining whether weirdness of disgust sensitivity items relates to moral judgments of purity transgressions (total $N = 805$). Weirder disgust sensitivity items were more strongly associated with moral judgments of purity, but not care, transgressions, suggesting support for the weirdness overlap hypothesis. However, we also find that the implications of this finding are limited. Eliminating the weirdest items from disgust sensitivity measures does not affect the tendency for the association between disgust sensitivity and moral judgments to be especially pronounced for purity transgressions. Therefore, although the weirdness of disgust sensitivity items is associated with the disgust sensitivity-purity link, it does not explain why disgust sensitivity is more strongly related to moral judgments of purity transgressions.

Disgust sensitivity influences moral decision-making (e.g., Laakasuo, Sundvall, & Drosinou, 2017; Van Leeuwen et al., 2017). The relationship between disgust sensitivity and moral issues is especially pronounced for moral transgressions of the purity moral domain (Horberg et al., 2009; Wagemans et al., 2018). While this disgust-purity link is established, it is not yet clear what psychological mechanism can account for the domain-specific relationship. Some argue that the relative weirdness of transgressions representing the purity domain plays a role (Gray & Keeney, 2015), but previous research investigating this possibility has focused solely on the weirdness of moral transgressions (Wagemans, Brandt, & Zeelenberg, 2017). In the current paper, we flip the perspective and test a "weirdness overlap" hypothesis: Does weirdness of items in disgust sensitivity measures predict their relationship to moral judgments of purity (i.e., weird) transgressions?

While disgust is thought to have evolved to protect us against diseases by distinguishing harmless from toxic foods, it has extended to moral contexts (Haidt et al., 1997; Rozin, Lowery et al., 1999; Tybur et al., 2009). One recurring finding is that individual differences in disgust sensitivity predict opposition to various moral and political issues, including homosexuality, abortion, and euthanasia (Crawford et al., 2014; Inbar, Pizarro, & Bloom, 2009; Inbar, Pizarro, Knobe et al., 2009; Jarudi, 2009; Olatunji, 2008; Smith et al., 2011; Terrizzi et al., 2010). This relationship between disgust sensitivity and the moral domain is especially strong for acts violating a purity norm, with studies (Horberg et al., 2009), including pre-registered studies (Wagemans et al., 2018), showing a consistently stronger relationship between disgust sensitivity and moral judgments of purity transgressions than moral judgments of transgressions of any other moral domain (i.e., care, authority, fairness, loyalty, and liberty).

Weirdness Overlap Hypothesis

What psychological mechanism can account for the disgust sensitivity-purity association? The "weirdness overlap" hypothesis is one potential explanation and involves the relative weirdness of moral transgressions of the purity domain. Gray and Keeney (2015) argued that a sampling bias of the moral domain resulted in purity transgressions (e.g., "Someone signs a piece of paper that says: I hereby sell my soul, after my death, to whoever has this piece of paper") that are substantially weirder than transgressions representing other moral domains (e.g., care: "Someone shoots and kills an animal that is a member of an endangered species"). While empirical studies do confirm that transgressions representing the purity domain are perceived to be weirder than other types of transgressions, they either do not test (Gray & Keeney, 2015) or do not find (Wagemans et al., 2017) that transgression weirdness explains why disgust sensitivity is more strongly related to purity moral judgments.

However, perceived weirdness might not only be relevant for moral judgment items, but might also be important for items measuring disgust sensitivity. Disgust is often experienced in response to atypical situations or stimuli, such as unknown or abnormal foods (e.g., insects, chocolate shaped as dog feces), close contact with strangers, and other unfamiliar situations (e.g., Curtis et al., 2004; Rozin, Haidt et al., 1999; Rozin, Millman, & Nemeroff, 1986). The reason that these situations and objects elicit disgust can be attributed to an overgeneralization of our behavioral immune system. In terms of survival, it is costlier to risk contact with infectious pathogens than it is to refrain from eating harmless foods or to avoid contact with potential cooperators (Haselton & Nettle, 2006; Park, Faulkner, & Schaller, 2003). When dealing with negative situations characterized by atypicality, the behavioral immune system thus biases towards risk avoidance (resulting in a disgust response) as we do not know whether these weird stimuli carry diseases.

Because many real-life disgust situations are atypical, measures of disgust sensitivity also include hypothetical situations that are weird; however, the level of weirdness varies. The frequently used Disgust Sensitivity Scale (Haidt et al., 1994) includes scenarios we find relatively normal (e.g., "I never let any part of my body touch the toilet seat in public restrooms"), but also scenarios we find substantially weirder ("I might be willing to try eating monkey meat, under some circumstances"). Disgust reactions to these weird disgust situations may be a good predictor of moral judgments of other weird situations, such as those of the purity domain. Hence, weird disgust sensitivity items should be more strongly related to moral judgments of purity (i.e., weird) transgressions. Put differently, we expect that the relationship between a disgust sensitivity item and moral judgments of purity transgressions depends, partly, on how weird that disgust sensitivity item is.

Weird or Infrequent?

Notably, many situations that elicit disgust are weird in the sense that they occur infrequently because people are generally motivated to withdraw from and avoid future contact with potentially contaminating objects or situations (e.g., Mortensen, Becker, Ackerman, Neuberg, & Kenrick, 2010; Olatunji, Haidt, McKay, & David, 2008). In line with the reasoning above, one could therefore argue that all disgust sensitivity items characterized by infrequency are more strongly related to weird purity moral judgments than disgust sensitivity items that occur more frequently. However, this assumes that weirdness and (in)frequency are similar constructs. This is not necessarily the case. Following Chakroff and Young (2015a), we distinguish between prescriptive abnormality (which we call weirdness) and statistical abnormality (which we call frequency). Weirdness is the degree to which a certain behavior deviates from a norm or social rules and frequency refers to how often a behavior occurs. While acts that are considered weird typically occur infrequently, the opposite is not always true. One example from a

measure of disgust sensitivity is the item, “Sharing an elevator with a man with a disfigured face” (London Disgust Scale; Curtis, 2013). Although this situation might not occur frequently in daily life, our data (below) show that it is not considered to be weird either.

Current study

We test our hypothesis that weirdness, but not (in)frequency, of disgust sensitivity items relates to the strength of their relationship with moral judgments of purity transgressions. We expect this relationship to be specific to transgressions of the purity domain (i.e., weird transgressions) and therefore use care moral judgments as a comparison domain that is not characterized by weirdness. We will also investigate whether the inclusion of weird disgust sensitivity items has consequences for the relationship between overall disgust sensitivity and moral judgments by testing if the stronger relationship between disgust sensitivity and moral judgments of purity versus care transgressions found in prior work (e.g., Wagemans et al., 2018) depends on the usage of highly weird disgust sensitivity items.

Study 4.1

Method

We collected data on the relationship between disgust sensitivity items and moral judgments of purity and care transgressions in Sample 1 and combine these with data from Sample 2 that rated disgust sensitivity items on their weirdness and frequency. [12]

Sample 4.1.

Participants. Based on the studies of Chapter 2 and guidelines on the minimum sample size needed to detect a stable

[12] All materials, data, and syntax used for analyses can be found in the supplemental materials at the Open Science Framework (OSF; Supplemental Materials via https://goo.gl/ZtLJqu).

correlation (Schönbrodt & Perugini, 2013), we planned to recruit 200 participants per disgust scale. As such, 600 MTurkers completed our study in return for a financial reward (316 males, 282 females, 2 other, M_{age} = 35.37, *SD* = 11.25).[13]

Materials. Participants judged 20 moral transgressions from a standardized set of vignettes based on Moral Foundations Theory (Clifford et al., 2015). Ten transgressions were from the purity domain (α = .89) and ten from the care domain (α = .91). Example items are, respectively, "You see a story about a remote tribe eating the flesh of their deceased members" and "You see a woman clearly avoiding sitting next to an obese woman on the bus". Participants indicated for each moral transgression how immoral they found the behavior on a scale ranging from 1 = 'Not at all immoral' to 7 = 'Extremely immoral'.

Next, participants were randomly assigned to fill out one of three disgust sensitivity measures: The 32-item Disgust Sensitivity Scale (DSS; Haidt et al., 1994; *N* = 201, α = .92), the 30-item London Disgust Scale (LDS; Curtis, 2013; *N* = 199, α = .94), and the 21-item Three Domain Disgust Scale (TDDS; Tybur et al., 2009; *N* = 200, α = .91). Example items for the DSS and LDS are, respectively, "You see maggots on a piece of meat in an outdoor garbage pail," and "Watching a woman pick her nose." The TDDS has three very distinct subscales; pathogen, sexual, and moral disgust. Example items are, respectively, "Standing close to a person who has body odor," "Finding out that someone you don't like has sexual fantasies about you," and "Deceiving a friend." Items of all scales were measured on a 7-point scale. Anchor labels for the first 17 items of the DSS were 1 = 'Strongly disagree (very untrue about me)' and 7 = 'Strongly agree (very true about me)'. For the remaining 15 items of the DSS and all

[13] Another 199 participants filled out the Disgust Propensity and Sensitivity Scale (Van Overveld, De Jong, Peters, Cavanagh, & Davey, 2006). This scale was not used in the current study, because it focuses on introspection (e.g., "I find something disgusting") and does not include hypothetical scenarios.

items of the TDDS and LDS these were 1 = 'Not at all disgusting' and 7 'Extremely disgusting'.

Sample 4.2.

Participants. To get reliable estimates of a disgust sensitivity item's weirdness and frequency, we aimed to collect ratings of at least 100 participant per set. In the end, 205 MTurkers completed the study in return for a financial reward (139 males, 65 females, 1 other, M_{age} = 33.78, SD = 9.77).

Materials. The 83 items of the abovementioned disgust sensitivity scales were divided into two sets (of 41 and 42 items) and each participant was randomly assigned to provide weirdness and frequency ratings of one of these sets (with order of items randomized across participants). Weirdness and frequency were assessed by asking participants to "Please indicate how weird (i.e., unusual, bizarre, odd) you find these situations" and to "Please indicate how frequently (i.e., typical or common) these situations occur in everyday life." Answers were given on a 7-point scale ranging from 1 = "Not at all weird [frequent]" to 7 = "Extremely weird [frequent]." Reliabilities of these ratings were for weirdness ICC_{set1} = .34 and ICC_{set2} = .42, both p's < .001, and for frequency ICC_{set1} = 0.35 and ICC_{set1} = .32, both p's < .001.

Results

The analyses proceed in three steps. First, in Sample 1, we replicate the finding we aim to explain, that disgust sensitivity is more strongly related to moral judgments of purity than care transgressions (Wagemans et al., 2018). Second, by combining the data from Sample 1 and 2, we investigate whether disgust sensitivity items' weirdness and frequency ratings predict their relationship to moral judgments of purity and care transgressions. Finally, we re-analyze the data of Sample 1 by testing disgust sensitivity's relationship to moral judgments of purity and care transgressions separately for highly weird and more normal disgust sensitivity items.

Disgust Sensitivity and Moral Domain Interaction. Linear mixed-effects models were used to test whether the data of Sample 1 replicate the finding that disgust sensitivity is more strongly related to moral judgments of purity than care transgressions, using the "lmer" function in the "lme4" and "lmerTest" packages of R (Bates et al., 2015; Kuznetsova et al., 2013). Confidence intervals were obtained using the "confint" function in the "stats" package using Monte Carlo simulations with 1000 bootstrap samples (R Core Team, 2017). All models take random variance of participants and moral judgment items into account. For the TDDS, analyses were conducted for each subscale separately, as is often the case with this scale (e.g., Park, Van Leeuwen, & Stephen, 2012; Tybur, Merriman, Caldwell Hooper, McDonald, & Navarrete, 2010). There is substantial overlap between the moral disgust subscale of the TDDS and transgressions of the care domain, which makes it more likely that this subscale shows the reversed pattern: A stronger relationship to moral judgments of care, as compared to purity, transgressions.

A model including disgust sensitivity (mean-centered), moral domain (1 = purity, 0 = care), and their interaction revealed an interaction effect of disgust sensitivity and moral domain on moral judgments for each of the disgust sensitivity (sub)scales. The coefficients for the interaction effects and their confidence intervals are presented in Figure 4.1. As expected, the DSS, the LDS, and the pathogen and sexual disgust subscales of the TDDS replicate the finding that disgust sensitivity is more strongly related to moral judgments of purity (DSS: $b = 0.74$, $SE = 0.08$, $p < .001$; LDS: $b = 0.47$, $SE = 0.08$, $p < 001$; TDDS-Pathogen: $b = 0.43$ $SE = 0.07$, $p < .001$, TDDS-Sexual: $b = 0.36$, $SE = 0.05$, $p < .001$) than care transgressions (DSS: $b = 0.50$, $SE = 0.08$, $p < 001$; LDS: $b = 0.20$, $SE = 0.08$, $p = .02$; TDDS-Pathogen: $b = 0.22$, $SE = 0.07$, $p = .002$, TDDS-Sexual: $b = 0.22$, $SE = 0.05$, $p < .001$). Although marginally significant, the moral disgust subscale of the TDDS followed the expected reversed pattern, with a stronger relationship between moral disgust sensitivity and moral judgments of care ($b = 0.32$, $SE =$

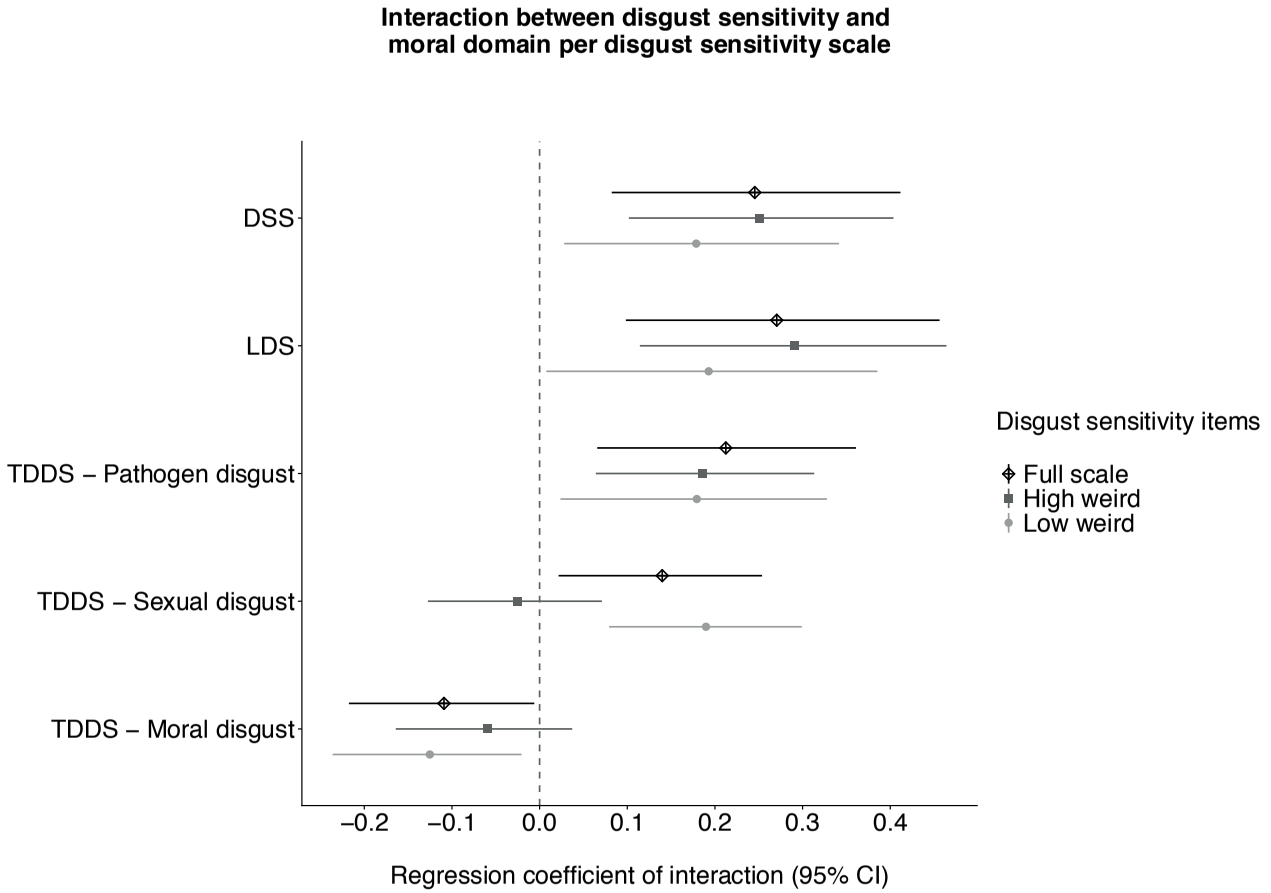


Figure 4.1. Unstandardized regression coefficients of the interaction between disgust sensitivity and moral domain (purity = 1, care = 0) on moral judgments, per disgust sensitivity scale for the full scale and split for items scoring high and low on weirdness. Positive coefficients indicate a stronger relationship to moral judgments of purity than care transgressions (and vice versa for negative coefficients).

0.04, $p < .001$), as compared to purity ($b = 0.21$, $SE = 0.05$, $p < .001$).

Consistent with the weirdness overlap hypothesis, there was a significant correlation between the weirdness of disgust sensitivity items and the strength of their relationship to purity moral judgments ($r[83] = .36$, $p < .001$, Figure 4.2, Top-Left Panel). Thus, the weirder a disgust sensitivity item is, the stronger that item's relationship is to moral judgments of purity transgressions. As expected, this relationship is specific to the purity domain, as no relationship was found between weirdness of disgust sensitivity items and the strength of their relationship to moral judgments of care transgressions ($r[83] = -.02$, $p = .87$. Figure 4.2, Bottom-Left Panel). Conducting the same analyses for frequency of occurrence did not yield any substantive results. A disgust sensitivity item's frequency was not correlated with the strength of its relationship to moral judgments of purity ($r[83] = -.11$, $p = .32$, Figure 4.2, Top-Right Panel), nor care ($r[83] = -.03$, $p = .81$, Figure 4.2, Bottom-Right Panel) transgressions.

Reanalysis of Disgust Sensitivity and Moral Domain Interaction. Are there consequences for including weird items in disgust sensitivity measures for research on the relationship between disgust sensitivity and moral judgments? We investigated this by testing whether the interaction between disgust sensitivity and moral domain depends on the inclusion of weird disgust sensitivity items. We re-analyzed the data from Sample 1 separately for disgust sensitivity items scoring below and above the median weirdness rating (i.e., 3.38) and compared the findings.

A model including disgust sensitivity (measured with items scoring high or low on weirdness; mean-centered), moral domain (1 = purity, 0 = care), and their interaction was fitted to the dataset of each (sub)scale. An interesting pattern emerged (see Figure 4.1). For the DSS, the LDS, and the pathogen subscale of the TDDS, the interaction between disgust sensitivity and moral domain tended to be slightly stronger when disgust sensitivity was measured with disgust sensitivity items scoring high on weirdness, as compared to

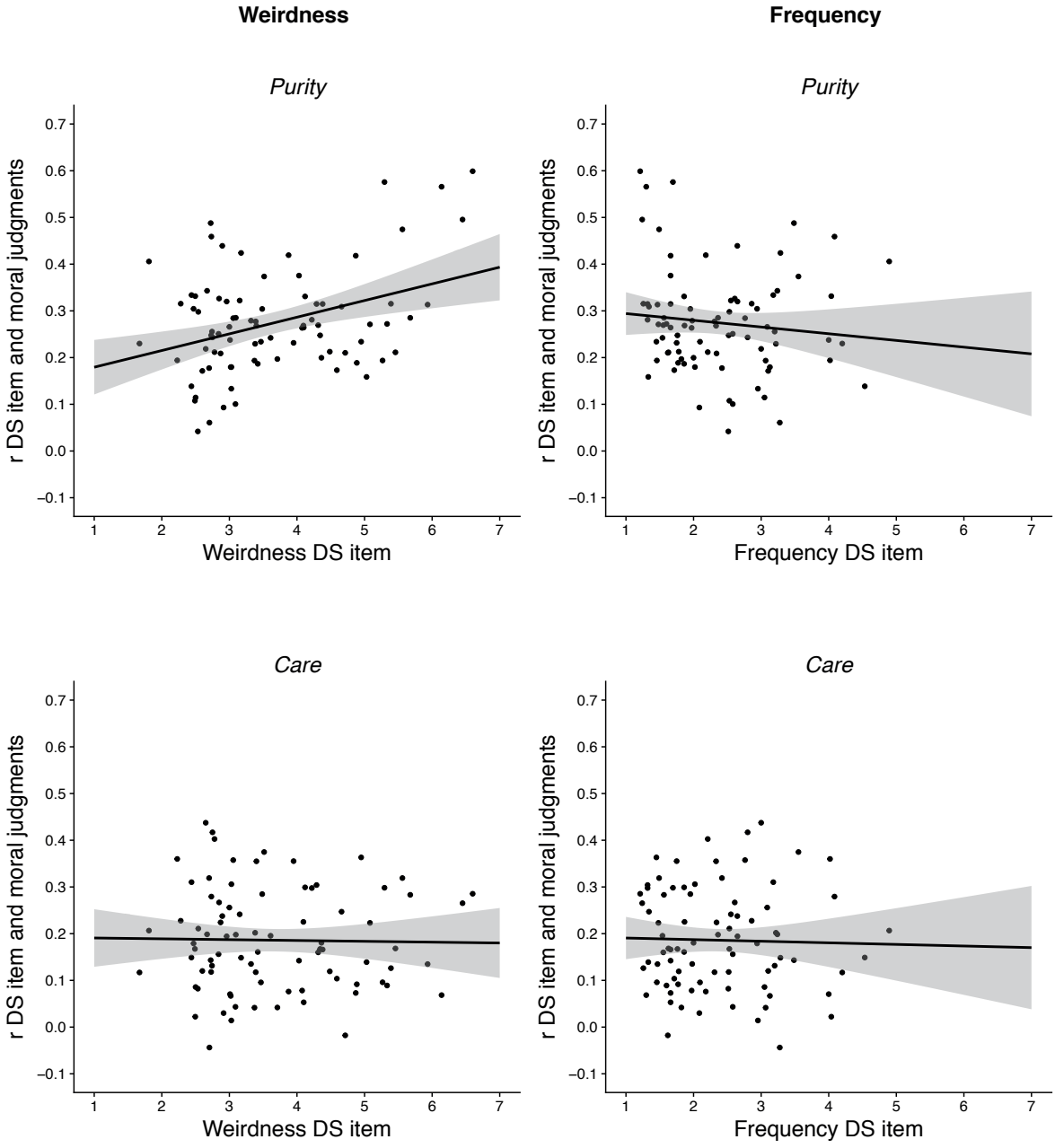


Figure 4.2. The relationship between weirdness and frequency of occurrence of disgust sensitivity items and their correlation with moral judgments per moral domain (purity versus care). Only the correlation displayed in the upper left panel, between weirdness of disgust sensitivity items and the strength of their relationship to purity moral judgments, is significant, $r(83) = .36$, $p < .001$.

when disgust sensitivity was measured with items scoring low on weirdness. However, these differences were quite small and well within the confidence intervals of the other estimates.

We conducted z-tests to test whether these interaction effects differed in magnitude for disgust sensitivity items scoring high and low on weirdness. For all but one sub(scale) no significant differences were found (all z's < 0.88, all p's $> .38$). Although we found a significant difference for the sexual disgust subscale of the TDDS ($z = 2.15$, $p = .03$), this was in the opposite direction of what was expected. Rather than becoming stronger and more positive, the interaction effect became non-significantly negative. That is, although at an item level, the weirdness of disgust sensitivity items may affect the size of the disgust sensitivity-purity judgment association (consistent with the weirdness overlap hypothesis), when used as a combined scale the effects of disgust sensitivity weirdness do not affect conclusions about the link between disgust sensitivity and moral judgments (inconsistent with the weirdness overlap hypothesis).

Discussion

We investigated whether the weirdness of disgust sensitivity items helps explain the finding that disgust sensitivity is more strongly related to moral judgments of purity, as compared to other types of, transgressions. Previous research showed that moral transgressions of the purity domain are substantially weirder than other types of moral transgressions, suggesting that weirdness might account for the disgust-purity link (Gray & Keeney, 2015). We tested a "weirdness overlap" hypothesis, which predicts that the weirdness of disgust sensitivity items relates to moral judgments of purity (i.e., weird) transgressions. The results of our study support that prediction and show that the relationship is specific to the moral domain of purity (i.e., weird transgressions) and not found for the care domain. Importantly, however, we find no evidence that the inclusion of weird

disgust sensitivity items explains the interaction between disgust sensitivity and moral domain.

In our study, we distinguished between a disgust sensitivity item's weirdness and frequency of occurrence. As expected, many of the disgust sensitivity items occurred relatively infrequently (no average frequency rating exceeded 4.90 on a scale ranging from 1 = 'Not at all frequent' to 7 = 'Extremely frequent', $M_{\text{frequency}} = 2.37$, $SD = 0.86$, median = 2.21), but were not necessarily perceived to be weird (on a scale ranging from 1 = 'Not at all weird to 7 = 'Extremely weird, $M_{\text{weirdness}} = 3.67$, $SD = 1.13$, median = 3.38). Even though the two constructs were highly correlated ($r[83] = -.80$, $p < .001$), they showed two distinct patterns of results. While disgust sensitivity items' weirdness ratings had a moderately strong correlation with the strength of items' relationship to moral judgments of purity transgressions, there was no such relationship for disgust sensitivity items' frequency of occurrence.

We tested the "weirdness overlap" hypothesis on the level of items. One limitation of this approach is that we treat an item's weirdness score as a constant factor and ignore potential individual differences in perceptions of weirdness. It could be that some individuals are more sensitive to weird situations in general, and because of that sensitivity react more negatively to both weird disgust sensitivity items (i.e., with more disgust) and weird moral judgment items (i.e., with more moral condemnation). However, while this logic explains why disgust sensitivity relates to moral judgments in general, it cannot explain why disgust sensitivity has a stronger relationship to moral judgments of purity specifically. In other words, it is not exactly clear why such weirdness sensitive individuals would react differently to variation in weirdness of purity and other types of transgressions.

Additionally, we want to note the potential importance of cultural norms on perceptions of weirdness and frequency. What may be weird or occur infrequently in one culture, might be relatively normal or even norm-abiding in another culture (e.g., the item "You

are served a dish made of cow's tongue and cheek"). In our study, we used an American sample because previous research on the relationship between disgust sensitivity and moral judgments and on the weirdness of purity transgressions has also mostly used American subjects. However, what is considered weird or not will likely shift from culture to culture.

Conclusion. The link between disgust sensitivity and purity issues has been found in many studies (Crawford et al., 2014; Horberg et al., 2009; Inbar, Pizarro, & Bloom, 2009; Inbar, Pizarro, Knobe et al., 2009; Jarudi, 2009; Olatunji, 2008; Smith et al., 2011; Terrizzi et al., 2010; Wagemans et al., 2018), but it is unclear what psychological mechanism explains why disgust sensitivity has a stronger relationship with moral judgments of purity as compared to other types of transgressions. We tested a weirdness overlap hypothesis. We reasoned that the presence of weird scenarios in disgust sensitivity scales might explain why disgust sensitivity relates more strongly to moral judgments of other weird scenarios (i.e., purity transgressions) as compared to moral judgments of relatively normal scenarios (i.e., care transgressions). However, even though we find that weirdness of disgust sensitivity items predicts their relationship to purity moral judgments, we do not find any evidence that the interaction between disgust sensitivity and moral domain is dependent on the inclusion of highly weird scenarios in disgust sensitivity scales. We therefore conclude it to be unlikely that the stronger relationship between disgust sensitivity and moral judgments of the purity domain is due to weirdness overlap.

5

Attentional biases associated with individual differences in disgust sensitivity: An eye tracking study

Based on: Wagemans, F. M. A., Sleegers, W. W. A., Brandt, M. J., & Zeelenberg, M. (in preparation). Attentional biases associated with individual differences in disgust sensitivity: An eye tracking study.

Chapter 5

Abstract

Individual differences in disgust sensitivity relate to a wide variety of psychological constructs (e.g., moral decision-making, political ideology, person perception) and are thought to play a role in the onset and maintenance of several psychopathological disorders (e.g., anxiety disorders, obsessive compulsive disorder, eating disorders). Despite its importance, research has yet to uncover the basic information processing styles that are associated with individual differences in disgust sensitivity. In the present article, we aimed to provide more insight into these processing styles and examined three attentional biases (vigilance, maintenance, and avoidance) for disgust stimuli as a function of disgust sensitivity. Using eye tracking methodology, two studies (total $N = 284$) found that the processing of disgust stimuli by disgust sensitive individuals is characterized by avoidance, but not by vigilance or disengagement difficulties in response to disgust stimuli. This finding is in line with the idea that more disgust sensitive individuals have a more sensitive pathogen threat alert system. Surprisingly though, disgust sensitive individuals showed the exact same attentional avoidance bias for other negative stimuli, suggesting that disgust sensitivity may be indicative of a more general defensive strategy than previously thought.

A considerable amount of theoretical and empirical research has focused on determining the function, elicitors, and behavioral consequences of disgust (e.g., Curtis & Biran, 2001; Rozin & Fallon, 1987; Tybur et al., 2013). Interestingly, the field still lacks a good understanding of the basic information processes underlying individual differences in disgust sensitivity. This is surprising given the evidence for the involvement of disgust sensitivity in many psychopathological disorders (for an overview, see Olatunji & McKay, 2009) and other important psychological constructs (e.g., Crawford et al., 2014; Hodson & Costello, 2007; Horberg et al., 2009; Inbar, Pizarro, & Bloom, 2009; Inbar et al., 2012; Inbar, Pizarro, Knobe et al., 2009; Olatunji, 2008; Shook et al., 2017; Terrizzi et al., 2010; Wagemans et al., 2018). In the current paper, we aim to provide more insight into these information processes by investigating whether individuals high and low in disgust sensitivity have different attentional biases for disgust stimuli. Based on existing literature we specify three hypotheses, each predicting their own relationship between disgust sensitivity and patterns of attention regarding disgust stimuli (i.e., vigilance, maintenance, and avoidance). The three hypotheses are then tested simultaneously in two eye tracking studies.

Disgust is thought to have originated as part of a food rejection system, discouraging the intake of harmful foods (Darwin, 1872; Rozin & Fallon, 1987). However, researchers have observed disgust responses to a substantially wider range of stimuli, including body products, animals, sex, death, and even norm violations (Chapman et al., 2009; Curtis & Biran, 2001; Haidt et al., 1997). It is therefore likely that disgust has evolved to serve a more general disease protection function and, as such, is experienced when encountering any type of situation that poses a contamination threat (Curtis & Biran, 2001; Oaten et al., 2009; Tybur et al., 2013). In line with this disease protection function, disgust's primary behavioral motivation is to avoid contact between the body and potential contaminants (Curtis & Biran, 2001). This avoidance reaction is not

only evident in actual withdrawal behaviors (Woody, McLean, & Klassen, 2005), but also in the facial expression accompanying a disgust experience, characterized by a raised upper lip, wrinkling of the nose, and narrowing of the eyes (Chapman et al., 2009; Vrana, 1993).

Although disgust is experienced by people across cultures, there is considerable individual variation in the extent to which people are prone to experience disgust intensely or easily (Haidt et al., 1994). This so-called disgust sensitivity or trait disgust is associated with various psychological constructs. Research in the field of social and political psychology has found that individual differences in disgust sensitivity are relevant for moral decision making (Horberg et al., 2009; Wagemans et al., 2018), and relate to political ideology (Inbar, Pizarro, & Bloom, 2009; Inbar et al., 2012; Shook et al., 2017; Terrizzi et al., 2010; however, also see Tybur et al., 2010) and attitudes towards a variety of groups, including homosexuals, foreigners, and immigrants (Crawford et al., 2014; Hodson & Costello, 2007; Inbar, Pizarro, Knobe et al., 2009; Olatunji, 2008). Similarly, a vast body of empirical and theoretical work has highlighted disgust sensitivity's involvement in many psychopathological disorders, such as animal phobias and general anxiety (De Jong & Merckelbach, 1998; De Jong, Peters, & Vanderhallen, 2002; Matchett & Davey, 1991; Mulkens, De Jong, & Merckelback, 1996; Muris et al., 1999), eating disorders (Aharoni & Hertz, 2011; Davey, Buckland, Tantow, & Dallos, 1998), and obsessive-compulsive disorder (OCD; Moretz & McKay, 2008; Muris et al., 2000; Olatunji, Lohr, Sawchuk, & Tolin, 2007; Tolin, Woods, & Abramowitz, 2005; Woody & Tolin, 2002).

Together, these findings show the many ways in which individuals high and low in disgust sensitivity can be distinguished. A question that follows, though, is what mechanism explains disgust sensitivity's relationship to many of these constructs. Although a lot of attention has been devoted to improving our understanding of disgust in the last decades, some of the basic cognitive processes associated

with disgust sensitivity still have to be examined. One such basic process that needs investigation is the information processing of disgust stimuli by individuals differing in disgust sensitivity. Knowing whether attentional biases are associated with individual differences in disgust sensitivity, and if so which biases, can not only further improve our understanding of disgust sensitivity itself, but it would also help clarify the mechanisms by which disgust sensitivity is related to many constructs (i.e., such as the ones described above).

For example, several studies have indicated that disgust sensitive individuals hold more negative attitudes of a variety of "deviant" groups (e.g., homosexuals, foreigners; Crawford et al., 2014; Hodson & Costello, 2007; Inbar, Pizarro, Knobe et al., 2009; Olatunji, 2008). One explanation for this relationship is that groups that deviate from the norm might pose a greater risk for disease and this contamination threat may be especially salient to disgust sensitive individuals (e.g., Park, Schaller, & Crandall, 2007; Terrizzi et al., 2010). However, two different information processing styles may underlie this explanation. One possibility is that the heightened perception of a contamination threat could lead disgust sensitive individuals to excessively focus on this threat. According to this explanation, negative attitudes towards these groups are thus the result of an inability to dissociate the contamination threat from the group. Alternatively, the heightened perception of a contamination threat could lead disgust sensitive individuals to avoid contact with members of these groups. This avoidant response not only prevents them from potential infectious diseases, but also impedes any chance of positive contact. If this is true, the negative attitudes towards these groups might primarily result from a lack of positive knowledge about this group (i.e., in line with the contact hypothesis; Allport, 1954; Pettigrew & Tropp 2006). Importantly, although both information processing styles ultimately lead to the exact same relationship between disgust sensitivity and attitudes of these groups, the explanation for this relationship greatly depends on the underlying

process, and also impacts which strategies for intervention may be most effective.

One way to reveal these automatic and non-conscious cognitive processes is by investigating the attentional biases involved with the processing of disgust stimuli. While attentional biases have been found for other personality traits (e.g., trait anxiety) and for some disorders (e.g., depression), it remains largely unclear what attentional biases are associated with disgust sensitivity, if any. Based on the existing literature, we specify three hypotheses that each predict a distinct attentional bias in information processing of disgust stimuli associated with individual differences in disgust sensitivity.

Vigilance Hypothesis

The *vigilance hypothesis* is based on the more general observation that emotionally salient stimuli draw attention (e.g., Asmundson & Stein, 1994; Mogg & Bradley, 2002; Mogg, Philippot, & Bradley, 2004; Öhman, Flykt, & Esteves, 2001; Richards & Blanchette, 2004; Watts, McKenna, Sharrock, & Trezise, 1986). It predicts that disgust sensitive individuals, for whom disgust stimuli are more motivationally salient, will be more attentive towards disgust stimuli. This vigilant attention consists of two components: A quick initial drawing of attention to the disgust stimulus when it appears, and continuous monitoring following the onset of this disgust stimulus.

There is, to our knowledge, no direct evidence supporting the idea that disgust sensitive individuals are more vigilant towards disgust stimuli. However, research on the attentional biases associated with individual differences in trait anxiety shows that these influence individuals' vigilance towards related stimuli. Several studies have found that more anxious individuals have a stronger initial drawing of attention towards threatening stimuli (i.e., faces or words) compared to less anxious individuals (Bradley, Mogg, Falla, & Hamilton, 1998; Bradley, Mogg, White, Groom, & De Bono, 1999; Fox, 1993; MacLeod & Matthews, 1988; Mogg, Millar, & Bradley,

2000). Additionally, Mogg and colleagues (2000) show some indication of continuous monitoring of emotionally salient stimuli by anxious individuals. Subjects with generalized anxiety disorder more often direct their attention to threatening faces than subjects with depression disorder or healthy subjects. A similar vigilant attentional bias might be at play for highly disgust sensitive individuals, but, as far as we know, no study yet has directly tested that possibility.

Maintenance Hypothesis

The *maintenance hypothesis* predicts that disgust sensitive individuals will have more difficulty disengaging from disgust stimuli. Like the vigilance hypothesis, this hypothesis builds on the notion that emotionally salient stimuli attract attention. However, the maintenance hypothesis differs from the vigilance hypothesis in that it focusses on what happens after detection of a disgust stimulus. According to the maintenance hypothesis, disgust sensitive individuals are more likely to keep attending to the disgust stimulus. It therefore implies a rather dysfunctional process as these individuals are also more likely to experience strong feelings of disgust in response to disgust stimuli. Indeed, neuropsychological research has shown that disgust sensitive individuals not only show stronger activation of disgust related brain regions in response to disgust elicitors, but also a weaker activation of regions related to emotion regulation (Mataix-Cols et al., 2008).

While this might sound counterintuitive, there is empirical work showing that emotionally salient cues tend to retain attention longer. For example, individuals scoring higher on a depression inventory take longer to disengage from depression-related images (Sears, Thomas, LeHuquet, & Johnson, 2010) and fixate their attention longer on negative pictures (Caseras, Garner, Bradley, & Mogg, 2007). Similar findings have been reported for trait anxiety, with anxious individuals having more difficulty disengaging from threat-related stimuli (i.e., faces or words) than non-anxious or less anxious individuals (Amir, Elias, Klumpp, & Przeworski, 2003; Fox,

Russo, Bowles, & Dutton, 2001; Fox, Russo, & Dutton, 2002; Salemink, Van den Hout, & Kindt, 2007). There is also some evidence that such a mechanism may be at play for disgust sensitivity and disgust stimuli. One study reports an attention bias towards disgust words (i.e., faeces) for disgust sensitive individuals (Cisler, Olatunji, Lohr, & Williams, 2009) and another study shows sustained engagement with disgust stimuli by more disgust sensitive individuals (Van Dillen & Vanderveen, 2017). However, these studies are either conducted with a small sample or use very brief stimuli exposure times (i.e., 120 ms), making it difficult to confirm that disgust sensitive individuals show prolonged engagement with disgust stimuli.

Avoidance Hypothesis

The *avoidance hypothesis* predicts that more disgust sensitive individuals will have a stronger avoidance reaction to disgust stimuli. The idea is that these individuals have a more sensitive pathogen threat alert system, which causes them to interpret even the slightest cue of contamination as a threat, resulting in an avoidance reaction. In other words, according to the avoidance hypothesis, higher levels of disgust sensitivity do not lead to a qualitatively different response after detecting a disgust stimulus, but come with a lower threshold for activating that response.

Although the theoretical argument behind this idea is compelling, the empirical evidence is lacking. Research has shown that disgust sensitive individuals are more likely to avoid contact with potentially contaminated objects and are less likely to engage in behaviors risking such contact (Deacon & Olatunji, 2007; Van Overveld, De Jong, & Peters, 2010). Similarly, Olatunji and colleagues (Olatunji, Lohr et al., 2007) found that disgust sensitivity mediated the relationship between contamination-related OCD symptoms and behavioral avoidance in a series of behavioral avoidance tasks. As far as we know, only one study shows some evidence for attentional avoidance of disgust stimuli for disgust

sensitive individuals. Woody and Tolin (2002) found that individuals scoring higher on the body envelope violation subscale of disgust sensitivity spent less time looking at blood injection pictures than individuals scoring lower on this subscale. However, the same study reports no such relationship between the animal disgust subscale and viewing time of spider pictures, even though these same subjects had responded with disgust (in addition to fear) to pictures of spiders in a previous study (see Tolin, Lohr, Sawchuk, & Lee, 1997). This study therefore only provides weak evidence for a general avoidant attentional bias associated with individual differences in disgust sensitivity.

Current Studies

We test each of the three hypotheses outlined above. Attentional processes will be assessed with an eye tracking task. Participants will engage in a free viewing task in which they will be presented with grids of pictures differing in emotional content (i.e., disgust, positive, neutral, and in Study 5.2, negative; see Figure 5.1). The benefit of using eye tracking technology over traditional tasks assessing attentional processes (e.g., dot probe or Stroop tasks) is that it can identify which stimuli grab attention, as well as measure the attention process continuously over time. We can therefore separate a vigilant attentional bias (i.e., initial orienting and subsequent monitoring) from a maintenance attentional bias (i.e., prolonged attention) towards a stimulus, while at the same time investigating the potential of an avoidant attentional bias (i.e., looking away). For each of the three hypotheses, we formulate distinct predictions of eye gazing patterns. We do so by investigating four different eye tracking measures: Time to first fixation, average visit duration, total visit duration, and visit count. We will explain these measures together with the exact predictions following from each hypothesis briefly below (see also Table 5.1).

Time to first fixation is the amount of time (in milliseconds) it takes participants to look at a specific area of interest (in our case, a

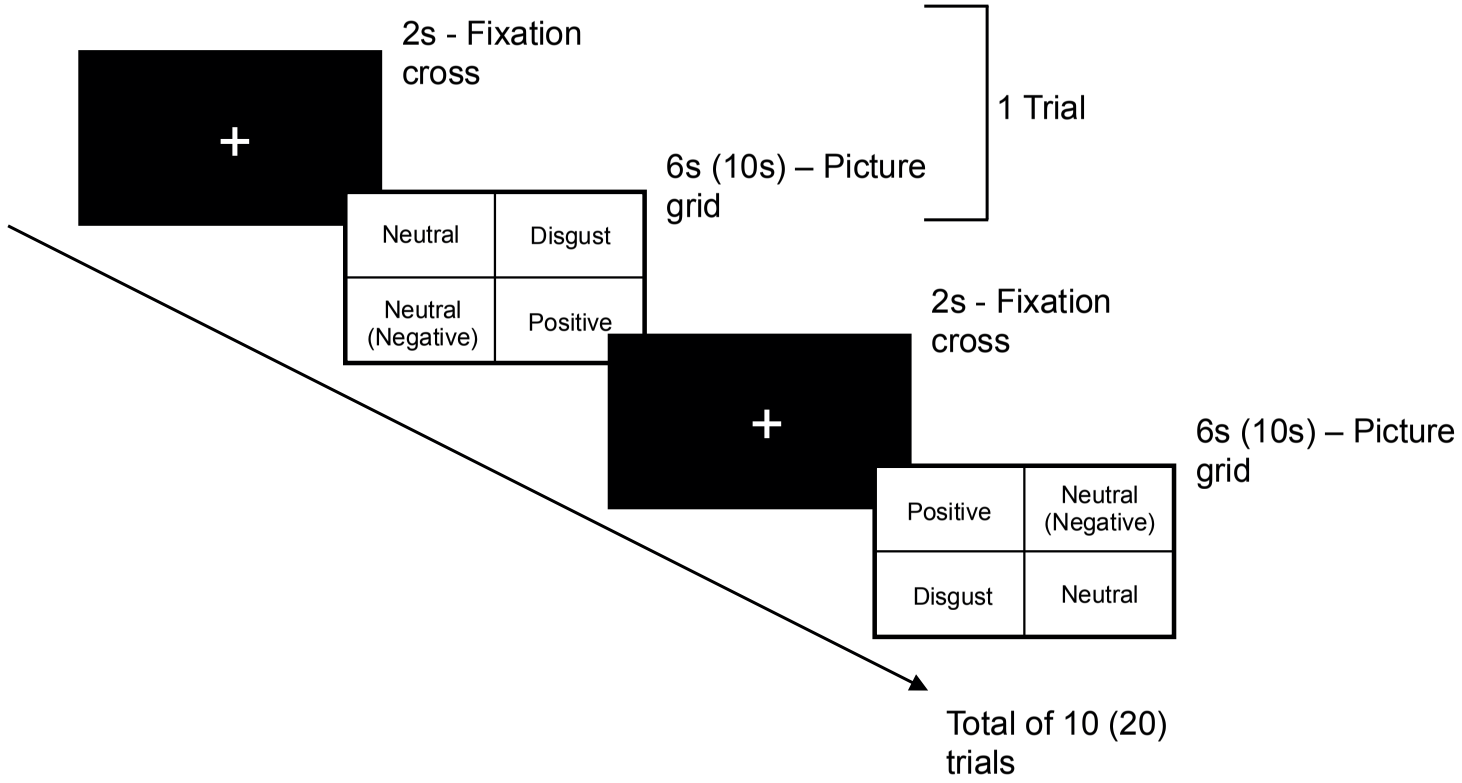


Figure 5.1. Visual representation of the free viewing task. Picture grids consisted of four pictures differing in emotional content with fully randomized picture presentation (except for Sample 1 in Study 5.1). Information between parentheses refers to changes made in stimulus presentation, exposure time, and task length in Study 5.2.

Table 5.1

Predictions of and support for the attentional biases of individual differences in disgust sensitivity (DS) per hypothesis.

Hypothesis	**Predictions**	**Study 5.1**	**Study 5.2**
Vigilance Hypothesis	Negative relationship between DS and time to first fixation for disgust pictures	✗	✗
	Positive relationship between DS and visit count for disgust pictures	✗	✗
Maintenance Hypothesis	Positive relationship between DS and average visit duration for disgust pictures	✗	✗
	Positive relationship between DS and total visit duration for disgust pictures	✗	✗
Avoidance Hypothesis	Negative relationship between DS and average visit duration for disgust pictures	✓	✓
	Negative relationship between DS and total visit duration for disgust pictures	✓	✓
	Negative relationship between DS and visit count for disgust pictures	✗	✓

certain picture) for the first time. In other words, this measure informs us about the detection speed of a given picture. The vigilance hypothesis follows from the idea that disgust pictures are more salient to highly disgust sensitive as compared to less disgust sensitive individuals. As such, this hypothesis would predict faster detection of, and thus a shorter time to first fixation on, disgust pictures by disgust sensitive individuals.

Average visit duration is the average time (in milliseconds) participants spend on each visit to a specific area of interest (in our case, a certain picture). A visit here means (re-)entering the area that defines a certain picture.[14] Average visit duration therefore gives us an indication of participants' viewing behaviors *after* detection of a given stimulus, which is relevant to both the avoidance and maintenance hypotheses. Importantly, these hypotheses make the exact opposite prediction regarding the relationship between disgust sensitivity and average visit duration of disgust stimuli. The avoidance hypothesis predicts that disgust sensitive individuals will have a stronger avoidance reaction to disgust stimuli, which would result in *shorter* average visit durations of disgust stimuli for disgust sensitive individuals compared to less disgust sensitive individuals. The maintenance hypothesis predicts the opposite; disgust sensitive individuals will have more difficulty disengaging from disgust stimuli, resulting in *longer* average visit durations of disgust stimuli for disgust sensitive, as compared to less disgust sensitive, individuals.

Total visit duration is the total amount of time (in milliseconds) spent within a specific area of interest (in our case, a certain picture). This measure is indicative of a general eye gazing strategy and can therefore again distinguish between an avoidance and maintenance hypothesis. The predictions following from these hypotheses on the relationship between disgust sensitivity and total

[14] Note that one visit can consist of multiple fixations, as participants can look at multiple spots within a given picture without looking away from this picture.

visit duration of disgust pictures are in line with the predictions for average visit duration. While the avoidance hypothesis predicts that disgust sensitive individuals will have *shorter* total visit durations of disgust pictures, the maintenance hypothesis predicts that they will have *longer* total visit durations of disgust pictures.

Visit count is the number of times participants (re-)enter a specific area of interest (in our case, a certain picture). While findings regarding average and total visit duration will be able to distinguish between the avoidance and maintenance hypotheses, visit count will help us distinguish between the vigilance and avoidance hypotheses. According to the vigilance hypothesis, disgust sensitive individuals will continuously monitor disgust stimuli, leading to a higher visit count of disgust pictures for these individuals. The avoidance hypothesis, on the contrary, predicts a lower visit count for disgust sensitive individuals as these individuals are more likely to avoid, and therefore less likely to return to, a disgust picture.

For an overview of the predictions regarding the relationship between disgust sensitivity and each of the eye tracking measure per hypothesis, see Table 5.1.

Study 5.1

Method

Data collection took place at festivals in 2017, in Tilburg, the Netherlands. A first sample was recruited at a music festival and a second sample was recruited at a social innovation festival. Sample size was in both cases determined by the number of visitors that wanted to participate in our study during two festival days (i.e., four days of data collection in total). The data of these samples is combined for our analyses to increase the power of our study.[15]

[15] The questionnaires, data, and syntax used for data analysis for all studies can be found in the supplemental materials at the Open Science Framework (OSF; Supplemental Materials via https://goo.gl/WpWXD6)

Sample 1.

Participants. Data collection took place in a large, well-lit room at Festival Mundial. The equipment was set up in the corner of this room to minimize distraction and no music was played in this room during the experiment (although music from outside the building could be heard). A marketing team of the university approached festival visitors outside of the building with the request to participate in the study. After two days of data collection, 99 visitors had participated. Participants were excluded when they did not fill out the survey (N = 5), did not participate in the eye tracker task (N = 2), and when they had substantial missing data in the eye tracking task (N = 1). This left us with a final sample of 91 participants (25 males, 66 females, M_{age} = 37.62, SD = 14.60).

Materials. To keep the questionnaire as short as possible, we used the pathogen disgust subscale of the Three Domain Disgust Scale (Tybur et al., 2009) to measure disgust sensitivity (7 items, α = .85)[16] All items were answered on a scale ranging from 1 = 'Not at all disgusting' to 7 = 'Extremely disgusting.' An example item of this scale is "Standing close to a person who has body odor."

Forty pictures were taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008), a well-validated database of pictures eliciting specific emotions. Ten disgusting pictures (e.g., dirty toilet, cockroaches), ten positive pictures (e.g., puppies, ice cream), and twenty neutral pictures (e.g., shoes, clock) were selected. Positive and disgust pictures were chosen for their similarity in complexity, the presence of animals, and the presence of people. For the eye tracking task, these pictures were presented in ten grids of four pictures (one disgusting, one positive, and two neutral). These grids were fixed in picture combination and

[16] Additional measures were included for exploratory purposes. In Sample 1, this was the moral disgust subscale of the Three Domain Disgust Scale (Tybur et al., 2009) and in Sample 2, these were 10 moral judgments of the Moral Foundations Vignettes (Clifford et al., 2015; see Supplemental Materials).

order, meaning that each individual saw the same combinations of pictures in the same order. The eye tracking task was conducted with the Tobii T60 (Tobii, Stockholm, Sweden).

Alcohol was available at the festival. To determine blood alcohol concentration (BAC) levels we used the AlcoScan AL7000 breathalyzer (measuring BAC levels in permille). Eighteen participants had BAC levels above 0, with a mean BAC level of 0.375‰ (SD = 0.25).[17]

Sample 2.

Participants. Data collection took place at the Dear Future, festival. On the first day, data collection took place in a well-lit and soundproof room. However, because the festival did not attract many visitors and the location of the room was not on the main path, equipment was moved to a more central location on the second day. Both days, the researchers themselves approached festival visitors with the request to participate in the study. After two days, 47 visitors had participated in the study. The same exclusion criteria as in Sample 1 were used. Participants were excluded because they did not fill out the survey (N = 2) and because they had substantial missing data in the eye tracking task (N = 1). This left us with a final sample of 44 participants (20 males, 24 females, M_{age} = 36.73, SD = 14.15).

Materials. Disgust sensitivity was measured with the 27-item Disgust Sensitivity Scale – revised (Haidt et al., 1994; modified by Olatunji, Williams et al., 2007, α = .84). The first 14 items of this scale are answered on a 5-point scale ranging from 1 = 'Strongly disagree (very untrue about me)' to 5 = 'Strongly agree (very true about me)'. An example item is "If I see someone vomit, it makes me sick to my stomach". The remaining 13 items are answered on a 5-point scale ranging from 1 = 'Not disgusting at all' to 5 = 'Extremely disgusting'. An example item is "You are about to drink a glass of milk

[17] As a reference point, the Dutch legal limit for driving is a BAC level of 0.5‰. Only four participants exceeded this limit. Excluding these participants from the analysis did not change any of our results.

when you smell that it is spoiled". The scale includes two filler items that are excluded from data analysis.

The same 40 IAPS pictures were used as in Sample 1, but we improved our design by randomizing picture presentation. More specifically, for each grid one disgusting, one positive, and two neutral pictures were randomly selected from the forty pictures (without repetition of pictures). Alcohol was again available at the festival, but none of the participants had BAC levels above 0. The same eye tracking equipment was used as in Sample 1.

Procedure. The procedure was the same in both samples. The first part of the study was administered on a tablet and consisted of informed consent and the disgust sensitivity questions. At the end of the questionnaire, participants provided demographic information and were asked whether they had consumed alcohol. If so, the breathalyzer was used to determine the blood alcohol concentration level. The second part of the study consisted of the eye tracking task. A researcher seated participants about half a meter from the eye tracker display and started the eye tracking calibration. After successful calibration, participants started the free-viewing task. This set-up (i.e., free viewing) was chosen to encourage naturalistic information processing. At the start of each trial, participants saw a fixation cross at the center of the screen for 2 seconds. They were then presented with one of the picture grids for 6 seconds. This was repeated for a total of ten trials. Participants were then debriefed and thanked for their participation.

Results

Data Analytic Strategy. As mentioned before, the two samples were analyzed together.[18] Linear mixed-effects models were used to estimate the effects of disgust sensitivity and picture type on each of the dependent variables, while taking into account random variance of participants, pictures, and samples. The analyses were conducted using the "lmer" function in the "lme4" package of R (Bates et al., 2015; R Core Team, 2017) and the "lmerTest" package was used to obtain *p*-values for coefficients (Kuznetsova et al., 2013). Because disgust sensitivity was measured with different answer scales in both samples, disgust sensitivity scores were mean-centered and standardized within each dataset (generating z-scores). Regarding the eye tracking data, fixations and visits were calculated by the authors in R using the "saccades" package (Von der Marlsburg, 2015). A model including disgust sensitivity (DS; standardized), picture type (reference category = neutral pictures), and their interaction as independent variables was then fitted to the data to predict each of the dependent variables (i.e., time to first fixation; average visit duration; total visit duration; visit count). Below, the findings will be described for each of the dependent variables separately.

Time to First Fixation. The vigilance hypothesis predicts that more disgust sensitive individuals will be faster in detecting the disgust pictures (i.e., have a shorter time to first fixation for disgust pictures) than less disgust sensitive individuals. This prediction is not supported by the data (see Figure 5.2A). The analyses reveal only a main effect of disgust pictures on time to first fixation (b = -369.97,

[18] Previous research has shown that the pathogen disgust subscale of the Three Domain Disgust scale has moderate to high correlations with all components of the Disgust Sensitivity Scale – Revised (Olatunji et al., 2012). Analyzing the data separately for each disgust sensitivity measure (i.e., sample) shows that the overall pattern of results is the same for both measures. However, the findings of sample 2 do not always reach significance, likely due to a small sample size.

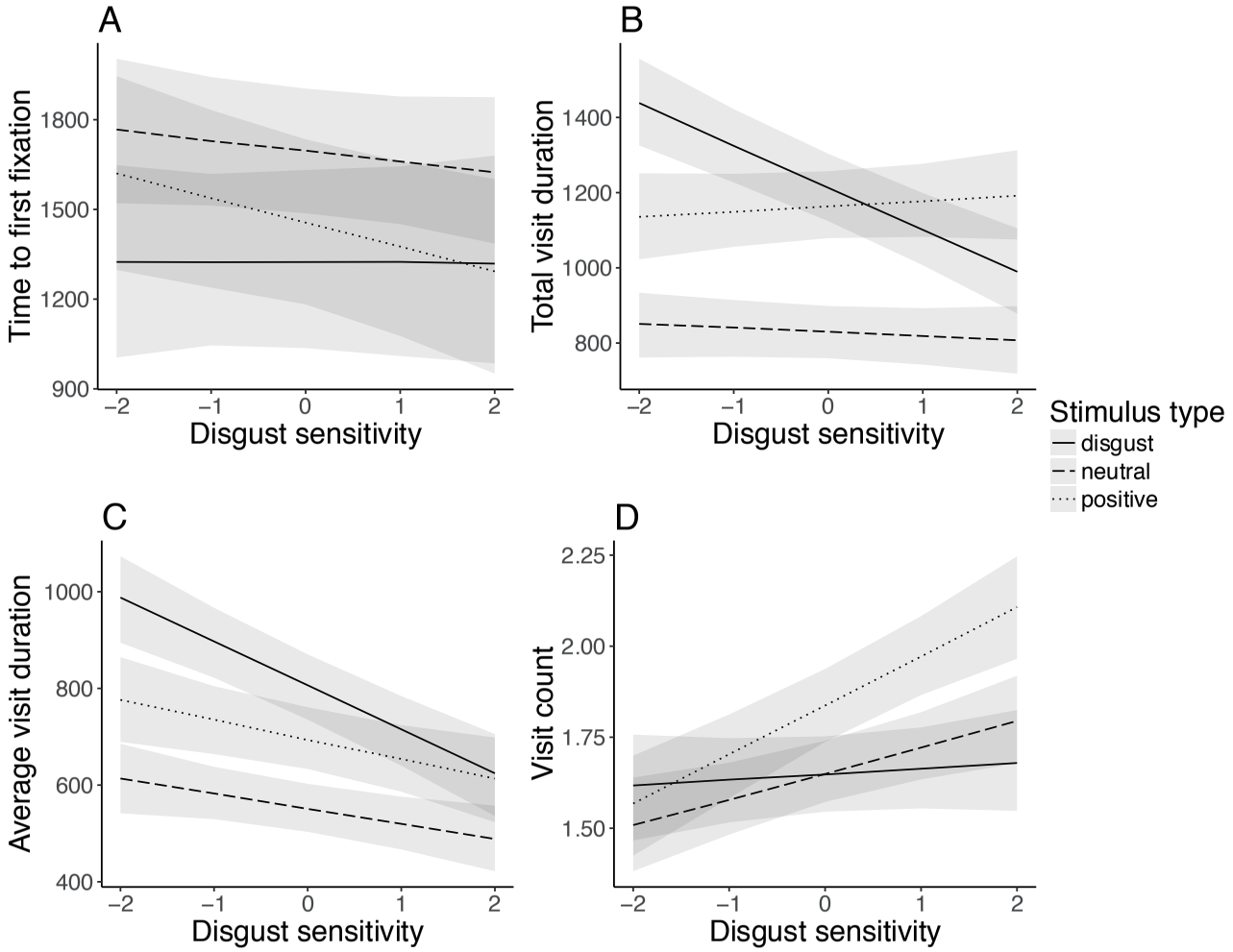


Figure 5.2. The relationship between disgust sensitivity and each of the eye tracking measures (time to first fixation, total visit duration, average visit duration, and visit count) per stimulus type for Study 5.1.

SE = 174.83, *t*[37] = -2.12, *p* = .04, 95% CI [-727.76, 1.16]), showing that individuals were faster in detecting the disgust pictures than the neutral pictures. However, there were no main effects of disgust sensitivity (*b* = -33.23, *SE* = 32.34, *t*[327] = -1.03, *p* = .31; 95% CI [-94.55, 29.17]) and positive pictures (*b* = -241.80, *SE* = 174.83, *t*[37] = -1.38, *p* = .17, 95% CI [-583.36, 94.04]), nor any interaction effects between disgust sensitivity and picture type (DS × disgust: *b* = 32.50, *SE* = 38.73, *t*[5731] = 0.84, *p* = .40, 95% CI [-38.43, 113.38]; DS × positive: *b* = -48.89, *SE* = 38.87, *t*[5729] = -1.26, *p* = .21, 95% CI [-122.88, 27.23]).

Average Visit Duration. The findings for average visit duration are in line with the prediction from the avoidance hypothesis, but go against the prediction from the maintenance hypothesis (see Figure 5.2B). There were main effects of disgust sensitivity, disgust pictures, and positive pictures (DS: *b* = -31.46, *SE* = 13.20, *t*[338] = -2.38, *p* = .02, 95% CI [-58.16, -7.99]); disgust: *b* = 255.97, *SE* = 38.17, *t*[37] = 6.71, *p* < .001, 95% CI [181.60, 326.93]; positive: *b* = 144.52, *SE* = 38.16, *t*[37] = 3.79, *p* < .001, 95% CI [69.93, 213.84]). There was no interaction effect between disgust sensitivity and positive pictures (*b* = -9.54, *SE* = 14.43, *t*[5187] = -0.66, *p* = .51, 95% CI [-39.18, 18.18]), but there was a significant interaction effect between disgust sensitivity and disgust pictures on average visit duration (*b* = -58.96, *SE* = 14.38, *t*[5188] = -4.10, *p* < .001, 95% CI [-85.71, -33.76]). As predicted by the avoidance hypothesis, more disgust sensitive individuals spent less time viewing disgust, as compared to neutral, pictures on average per visit than less disgust sensitive individuals did.

Total Visit Duration. The findings for total visit duration largely mimicked the pattern found for average visit duration (see Figure 5.2C). Hence, these findings were again in line with the avoidance hypothesis, while going against the maintenance hypothesis. There was no main effect of disgust sensitivity (*b* = -10.88, *SE* = 13.80, *t*[343] = -0.79, *p* = .43, 95% CI [-40.69, 15.53]), but main effects of both disgust and positive pictures (disgust: *b* =

381.71, *SE* = 52.14, *t*[37] = 7.32, *p* < .001, 95% CI [290.39, 470.52]; positive: *b* = 336.66, *SE* = 52.14, *t*[37] = 6.46, *p* < .001, 95% CI [229.33, 447.29]). There was no interaction effect of disgust sensitivity and positive pictures (*b* = 24.65, *SE* = 20.72, *t*[5134] = 1.19, *p* = .23, 95% CI [-16.20, 69.97]), but there was a significant interaction between disgust sensitivity and disgust pictures on total visit duration (*b* = -101.12, *SE* = 20.64, *t*[5137] = -4.90, *p* < .001, 95% CI [-141.49, -62.11]). As predicted by the avoidance hypothesis, more disgust sensitive individuals spent less time viewing disgust, as compared to neutral, pictures overall than less disgust sensitive individuals did.

Visit Count. The vigilance hypothesis predicts that more disgust sensitive individuals will visit disgust pictures more often than less disgust sensitive individuals, while the avoidance hypothesis predicts exactly the opposite pattern. However, neither predictions were supported by the data (see Figure 5.2D). Main effects were found for disgust sensitivity and positive pictures (DS: *b* = 0.07, *SE* = 0.02, *t*[347] = 3.21, *p* = .001, 95% CI [0.03, 0.11]; positive: *b* = 0.19, *SE* = 0.05, *t*[37] = 3.65, *p* < .001, 95% CI [0.09, 0.28]), but not for disgust pictures (*b* = -0.004, *SE* = 0.05, *t*[37] = -0.08, *p* = .94, 95% CI [-0.10, 0.10]). The interaction between disgust sensitivity and disgust pictures, as well as the interaction between disgust sensitivity and positive pictures, was significant (DS × disgust: *b* = -0.06, *SE* = 0.02, *t*[5071] = -2.32, *p* = .02, 95% CI [-0.10, -0.02]; DS × positive: *b* = 0.06, *SE* = 0.02, *t*[5070] = 2.70, *p* = .01, 95% CI [0.02, 0.11]). Disgust sensitive individuals visited positive, as compared to neutral, pictures more often than less disgust sensitivity individuals did. However, while there was an interaction effect of disgust sensitivity and disgust pictures, there was no effect of disgust sensitivity on visit count for disgust pictures (*b* = 0.02, *SE* = 0.03, *t*[167.51] = 0.53, *p* = .60, 95% CI [-0.04, 0.07]). Rather, this interaction effect can be attributed to a positive relationship between disgust sensitivity and visit count for neutral pictures (*b* = 0.06, *SE* =

0.02, t[177.80] = 2.56, p = .01, 95% CI [0.02, 0.10]; see Figure 5.2D).

Discussion

Our first study primarily supports the avoidance hypothesis, showing that individuals high in disgust sensitivity spend less time looking at disgust pictures than individuals low in disgust sensitivity. We found this pattern for both average and total visit duration of disgust pictures. The avoidance hypothesis also predicts that individuals high in disgust sensitivity will visit disgust pictures less often than individuals low in disgust sensitivity do, but this prediction was not supported by the data of Study 5.1. We also found no support in Study 5.1 for any of the predictions following from either a vigilance or a maintenance hypothesis (see Table 5.1).

Study 5.1 was set up as an exploratory test and so we aimed to replicate these findings in a second study. We improved our study with regard to three aspects. First, Study 5.2 was conducted in a controlled lab environment instead of in the field. Study 5.1 was conducted at festivals, which provided us with the benefit of collecting data among a wide variety of people from the general public (i.e., a non-student sample). However, this setting also limited the level of methodological control over our study because of the presence of potential distractors. We will therefore test whether the pattern found in Study 5.1 replicates in a more controlled setting. Second, we extend our experimental design with the inclusion of negative, but not disgusting, pictures. This way we can test whether the effects found for disgust sensitivity in Study 5.1 are specific to disgust stimuli, or apply to negative stimuli in general. Third, to get a more precise estimate of our effect, we increased the number of trials in Study 5.2 from 10 to 20. Additionally, we preregistered the three hypotheses and their predictions regarding the eye tracking task, as well as the statistical analyses we planned to run at the Open Science Framework (see the preregistration file).

Study 5.2

Method

Participants. We ran the study for two weeks in the SP-lab at Tilburg University. Sample size was determined by the number of students that participated in our lab study during this time, with a minimum sample size set at 120 participants. In the end, 149 students (43 males, 103 females, 3 missing, M_{age} = 19.95, SD = 2.30, with 1 missing) participated in our study in return for course credit.

Materials. The same disgust sensitivity scale as in Sample 2 of Study 5.1 was used (i.e., Disgust Sensitivity Scale – revised; Haidt et al., 1994; modified by Olatunji, Williams et al., 2007, α = .84).[19]

Pictures were again selected from the International Affective Picture System (Lang et al., 2008). A total 80 pictures were selected (which included the 40 pictures from Study 5.1), evenly divided over four picture categories: disgust[20], negative, positive, and neutral. Examples of negative pictures are an airplane crash, a gun, and a shark. Picture presentation was again randomized, while ensuring that each grid included one disgusting, one negative, one positive, and one neutral picture. The same eye tracking equipment was used as in Study 5.1.

Procedure. Participants were seated in individual soundproof cubicles in the lab, where they gave consent and answered the questions measuring disgust sensitivity. They were then taken to another cubicle for the eye tracking task. A test leader seated participants about half a meter from the eye tracker display and started the eye tracking calibration. After successful calibration, participants started the free-viewing task. At the start of each trial,

[19] The same 10 moral judgment items as in Sample 2 of Study 5.1 were included for exploratory purposes (i.e., Moral Foundations Vignettes; Clifford et al., 2015), but will not be discussed here.

[20] We later found out that due to a mistake in the design of our study only 19 different disgust pictures were presented in the task and one disgust picture was always repeated.

participants saw a fixation cross at the center of the screen for 2 seconds. They were then presented with one of the picture grids for 10 seconds. This was repeated for a total of twenty trials. After this free viewing task, participants indicated for each of the disgust and negative pictures how disgusting [negative] they found the picture on a scale from 1 = 'Not at all disgusting (negative)' to 7 = 'Very disgusting (negative).' Participants were then debriefed and thanked for their participation.

Results

Data Analytic Strategy. The data analytic strategy was identical to that of Study 5.1, except that there was no need to take into account random variance of samples. Statistical analyses were first conducted using neutral pictures as the reference category, but were also conducted using negative pictures as the reference category. By doing this, we could test whether the attentional biases associated with individual differences in disgust sensitivity are specific to disgust pictures or can be generalized to other negative pictures. Because participants rated the disgust and negative pictures on disgustingness and negativity, we were also able to conduct a manipulation check on these pictures.

Manipulation Check. For each participant, average disgustingness and average negativity scores were calculated for disgust and negative pictures. As expected, disgust pictures (M = 4.93, SD = 0.99) were rated as significantly more disgusting than negative pictures (M = 2.32, SD = 1.14; $t(149) = 26.75$, $p < .001$). However, disgust pictures (M = 4.84, SD = 1.16) were also rated as slightly more negative than negative pictures (M = 4.58, SD = 1.15; $t(149) = 2.76$, $p = .01$).

Time to First Fixation. As in Study 5.1, findings for time to first fixation did not support the prediction from the vigilance hypothesis that more disgust sensitive individuals will have shorter times to first fixation for disgust pictures (see Figure 5.3A). There were main effects of disgust, positive, and negative pictures (disgust:

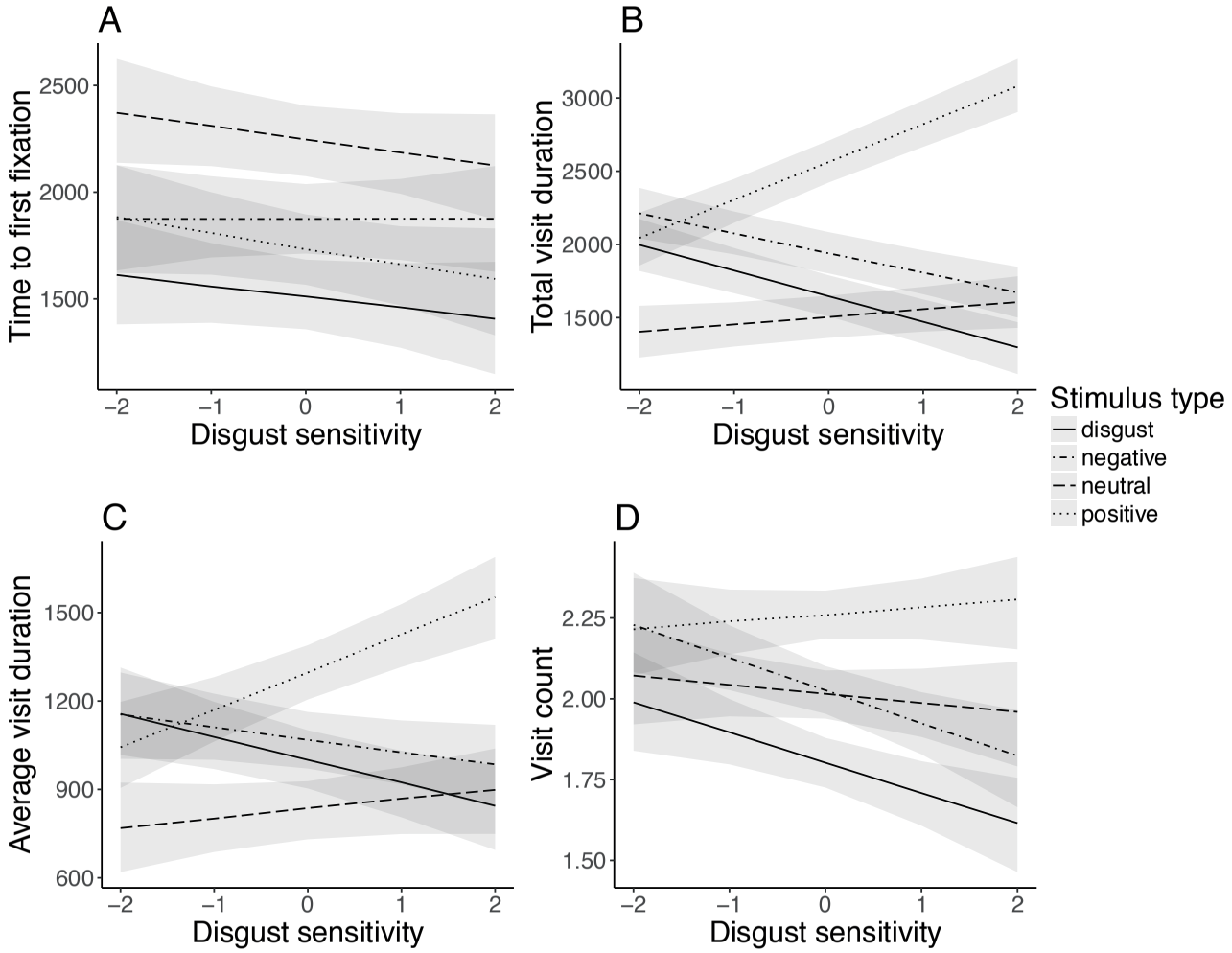


Figure 5.3. The relationship between disgust sensitivity and each of the eye tracking measures (time to first fixation, total visit duration, average visit duration, and visit count) per stimulus type for Study 5.2.

b = -733.62, *SE* = 105.06, *t*[75] = -6.98, *p* < .001, 95% CI [-918.66, -536.77]; positive: *b* = -515.75, *SE* = 103.79, *t*[75] = -4.97, *p* < .001, 95% CI [-731.75, -308.95]; negative: *b* = -374.57, *SE* = 103.81, *t*[75] = -3.61, *p* < .001, 95% CI [-563.97, -181.12]). Regardless of disgust sensitivity, participants were faster in detecting disgust, positive, and negative pictures than neutral pictures. No main effect of disgust sensitivity was found (*b* = -62.96, *SE* = 47.43, *t*[287] = -1.33, *p* = .19, 95% CI [-156.38, 34.56]), nor did any of the interaction effects between disgust sensitivity and picture type reach significance (DS × disgust: *b* = 9.86, *SE* = 41.12, *t*[13929] = 0.24, *p* = .81, 95% CI [-68.30, 90.46]; DS × positive: *b* = -11.90, *SE* = 41.03, *t*[13933] = -0.29, *p* = .77, 95% CI [-93.54, 63.85]; DS × negative: *b* = 61.15, *SE* = 41.10, *t*[13932] = 1.49, *p* = .14, 95% CI [-19.55, 144.41]).

Average Visit Duration. Findings for average visit duration replicate the pattern found in Study 5.1. The data again support the prediction following from an avoidance hypothesis, but not the prediction following from a maintenance hypothesis (see Figure 5.3B). There was no main effect of disgust sensitivity (*b* = 32.25, *SE* = 27.76, *t*[228] = 1.16, *p* = 0.25, 95% CI [-23.14, 85.05]). There were main effects of disgust, positive and negative pictures (disgust: *b* = 168.05, *SE* = 62.40, *t*[75] = 2.69, *p* = .009, 95% CI [48.81, 290.68] positive: *b* = 462.77, *SE* = 61.64, *t*[75] = 7.51, *p* <.001, 95% CI [326.52, 583.13], negative: *b* = 233.90, *SE* = 61.64, *t*[75] = 3.79, *p* < .001, 95% CI [116.27, 358.29]). However, these main effects were qualified by significant interactions between disgust sensitivity and each of the picture types (DS × disgust: *b* = -111.50, *SE* = 21.50, *t*[12826] = -5.19, *p* < .001, 95% CI [-151.70, -68.05]; DS × positive: *b* = 94.88, *SE* = 21.46, *t*[12829] = 4.42, *p* < .001, 95% CI [52.07, 134.13]; DS × negative: *b* = -72.59, *SE* = 21.49, *t*[12828] = -3.38, *p* < .001, 95% CI [-113.68, -28.53]). More disgust sensitive individuals spent significantly more time viewing positive, as compared to neutral, pictures than less disgust sensitivity individuals did. As predicted by the avoidance hypothesis, more disgust sensitive

individuals spent less time viewing disgust, as compared to neutral, pictures on average per visit than less disgust sensitive individuals did. Interestingly, this effect of disgust sensitivity on average visit duration of disgust pictures was not significantly different from disgust sensitivity's effect on average visit duration of negative pictures (b = -38.92, SE = 21.46, t[10892] = -1.81, p = .07, 95% CI [-83.76, 3.01]). Disgust sensitive individuals thus spent less time on average per visit looking at both disgust and negative pictures than less disgust sensitive individuals.

Total Visit Duration. The findings for total visit duration again mimicked the pattern found for average visit duration, and thus supported an avoidance, but not maintenance, hypothesis (see Figure 5.3C). There were no main effects of disgust sensitivity and disgust pictures (DS: b = 49.43, SE = 26.73, t[563] = 1.85, p = .06, 95% CI [-4.98, 98.11]; disgust: b = 142.41, SE = 103.43, t[75] = 1.38, p = .17, 95% CI [-75.69, 322.22]). There were main effects of negative and positive pictures (negative: b = 437.16, SE = 102.16, t[75] = 4.28, p <.001, 95% CI [216.23, 624.44]; positive: b = 1060.80, SE = 102.15, t[75] = 10.39, p < .001, 95% CI [841.49, 1254.97]). These main effects were qualified by significant interaction effects between disgust sensitivity and each of the picture types (DS × disgust: b = -224.96, SE = 33.52, t[12626] = -6.71, p < .001 , 95% CI [-293.85, -164.70]; DS × positive: b = 210.30, SE = 33.44, t[12640] = 6.29, p < .001, 95% CI [144.68, 276.13]; DS × negative: b = -185.39, SE = 33.50, t[12636] = -5.53, p < .001, 95% CI [-249.05, -125.57]). More disgust sensitive individuals spent significantly more time viewing positive, as compared to neutral, pictures than less disgust sensitivity individuals did. As predicted by the avoidance hypothesis, disgust sensitivity was negatively related to total viewing time of disgust, as compared to neutral, pictures. Again, this effect of disgust sensitivity was not significantly different for disgust as compared to negative pictures (b = -39.57, SE = 33.45, t[11455] = -1.18, p = .24, 95% CI [-104.74, 17.69]). Participants high in disgust sensitivity thus spent

less time overall looking at disgust as well as negative pictures than participants low in disgust sensitivity.

Visit Count. The avoidance hypothesis predicts that more disgust sensitive individuals will visit disgust pictures less often, while the vigilance hypothesis predicts exactly the opposite pattern. In contrast to Study 5.1, in which neither of the predictions were supported, the data now clearly support the prediction following from an avoidance hypothesis (see Figure 5.3D). There were no main effects for disgust sensitivity and negative pictures (DS: b = -0.03, SE = 0.03, t[211] = -0.81, p = .42, 95% CI [-0.08, 0.04]; negative: b = 0.01, SE = 0.03, t[77] = 0.41, p = .68, 95% CI [-0.05, 0.08]). There were main effects for disgust pictures and positive pictures (disgust: b = -0.21, SE = 0.03, t[76] = -6.09, p < .001 , 95% CI [-0.28, -0.14]; positive: b = 0.25, SE = 0.03, t[77] = 7.23, p < .001, 95% CI [0.18, 0.31]). These main effects were qualified by significant interaction effects between disgust sensitivity and each of the picture types (DS × disgust: b = -0.07, SE = 0.02, t[11512] = -2.97, p = .003, 95% CI [-0.11, -0.02]; DS × positive: b = 0.05, SE = 0.02, t[11514] = 2.25, p = .02, 95% CI [0.01, 0.09]; DS × negative: b = -0.07, SE = 0.02, t[11514] = -3.30, p < .001, 95% CI [-0.12, -0.03]). More disgust sensitive individuals visit positive, as compared to neutral, pictures more often than less disgust sensitivity individuals. As predicted by the avoidance hypothesis, disgust sensitivity was negatively related to visit count of disgust, as compared to neutral, pictures. However, also the effect of disgust sensitivity on visit count was not significantly different from disgust sensitivity's effect on visit count of negative pictures (b = 0.01, SE = 0.02, t[11513] = 0.33, p = .74, 95% CI [-0.04, 0.05]). Participants high in disgust sensitivity thus visit disgust as well as negative pictures less often than participants low in disgust sensitivity.

All predictions following from an avoidance hypothesis were therefore supported, while none of the predictions following from either a vigilance or a maintenance hypothesis were supported (see Table 5.1).

Chapter 5

General Discussion

Individual differences in disgust sensitivity are important to many psychological constructs and disorders (e.g., Aharoni & Hertz, 2011; Crawford et al., 2014; De Jong & Merckelbach, 1998; Inbar et al., 2012; Olatunji, Lohr et al., 2007; Wagemans et al., 2018). To further improve our understanding of disgust sensitivity, we examined the basic information processing strategies associated with individual differences in disgust sensitivity. Based on the existing literature on disgust sensitivity and research that identified attentional biases for other personality traits, we formulated three hypotheses that each predict different attentional biases for disgust stimuli as a function of individual differences in disgust sensitivity. The first two hypotheses build on the notion that emotionally salient stimuli tend to attract our attention. The vigilance hypothesis predicts that disgust sensitive individuals will be more attentive towards disgust stimuli, resulting in a quick drawing of attention towards and continuous monitoring of disgust stimuli. The maintenance hypothesis differs in that it focusses on what happens after detection of disgust stimuli. This hypothesis predicts that disgust sensitive individuals have more difficulty disengaging from disgust stimuli, resulting in longer dwell times on disgust stimuli after detection. The last hypothesis, the avoidance hypothesis, argues that disgust sensitive individuals have a more sensitive pathogen threat alerting system, resulting in a stronger avoidance reaction. It is incompatible with the first two hypotheses as it predicts that disgust sensitive individuals will spend *less* attention on disgust stimuli.

In two studies, we used eye tracking methodology to simultaneously test these three hypotheses and found strong support for the avoidance hypothesis. Disgust sensitive individuals showed strong attentional avoidance of disgust stimuli, with these individuals spending less time looking at disgust stimuli, per visit and overall, and less often returning their gaze to these stimuli. None of the

predictions following from the vigilance and maintenance hypotheses were supported by our data (for an overview see Table 5.1).

This supports the idea that more disgust sensitive individuals have a more sensitive pathogen threat alert system than less disgust sensitive individuals. Interestingly, our second study reveals that this attentional avoidance bias associated with individual differences in disgust sensitivity may not be specific to disgust stimuli alone. Disgust sensitive individuals show the exact same attentional avoidance bias for other negative stimuli. While this finding suggests that disgust sensitivity may be indicative of a more general defensive strategy than previously thought, it could also be that more disgust sensitive individuals perceive contamination threats even when, objectively, there is no threat present. If this is the case, more disgust sensitive individuals have a stronger signal detection problem than less disgust sensitive individuals, characterized by a higher false alarm rate (Oaten et al., 2009). This would suggest that the pathogen threat alert system of disgust sensitive individuals is not only *more* sensitive, but also *oversensitive* to cues of contamination. We used the data of Study 5.2 on disgust sensitivity and perceived disgustingness ratings of negative stimuli for a preliminary test of this idea. When selecting these negative stimuli, we ensured that they were free of cues that typically elicit pathogen or moral disgust. Nevertheless, we find that more disgust sensitive individuals perceived negative stimuli to be more disgusting than less disgust sensitive individuals ($r[147] = .33$, $p < .001$). Although this looks promising, future research should more directly investigate whether disgust sensitive individuals indeed perceive contamination threats in pathogen-free environments.

These findings can benefit our understanding of disgust sensitivity's relationship to other constructs and serve to inspire testable hypotheses. For example, in the introduction we highlighted how the relationship between disgust sensitivity and attitudes towards outgroups can be the result of, at least, two different information processing strategies (i.e., avoidance and maintenance). Our studies distinguished between these strategies and revealed that

disgust sensitive individuals display attentional avoidance of disgust and negative stimuli. Based on this, one testable hypothesis that our work can suggest is that it might be the case that disgust sensitive individuals hold more negative attitudes of outgroup members because the heightened perception of a disease threat leads them to avoid contact with these groups. In line with intergroup contact theory (Pettigrew & Tropp, 2006), this avoidance hinders disgust sensitive individuals to overcome prejudices that are typically associated with these groups. However, our results also indicate that disgust sensitive individuals might even perceive such a contamination threat in the absence of actual contamination risks. Avoidance of outgroups could therefore be instigated by the perception of any negative act, as disgust sensitive individuals seem to respond with strong avoidance to generally negative cues as well.

The current findings might also be relevant for research on and treatment of disorders in which disgust sensitivity plays a role. The attentional avoidance bias suggests that disgust sensitive individuals have an oversensitive pathogen threat alert system. When designing targeted interventions to reduce this information processing bias in disgust sensitive individuals, those aimed at desensitizing the pathogen threat alert system might be most successful. While studies investigating traditional exposure therapy for disgust show mixed results (e.g., McKay, 2006; Olatunji, Wolitzky-Taylor, Willems, Lohr, & Armstrong, 2009), the effectiveness of alternative interventions, such as counterconditioning or conceptual reorientation, still has to be determined (for an overview, see Mason & Richardson, 2012).

A limitation of our study is that we did not compare disgust sensitivity's biases directly to those of another personality trait, such as trait anxiety. Several studies have shown disgust sensitivity's close relationship to anxiety disorders (De Jong & Merckelbach, 1998; De Jong et al., 2002; Matchett & Davey, 1991; Mulkens et al., 1996; Muris et al., 1999). Interestingly though, the attentional bias associated with stronger disgust sensitivity does not match the attentional bias found for highly anxious individuals. While anxious

individuals show prolonged engagement with threat-related stimuli (Amir et al., 2003; Fox et al., 2001; Fox et al., 2002; Salemink, et al., 2007), we find that more disgust sensitive individuals display stronger avoidance of negative stimuli. It therefore seems that individual differences in trait anxiety and trait disgust lead to changes in distinct components of information processing. The findings for trait anxiety point to difficulties in effective responding to emotionally salient cues for highly anxious individuals (i.e., an inability to dismiss threatening cues). For more disgust sensitive individuals, on the contrary, the *response* to disgust stimuli seems unaffected (i.e., avoidance), but the *perception* of stimuli is different. To further improve our understanding of the respective roles of trait anxiety and trait disgust in anxiety disorders, future research should investigate these traits simultaneously and determine how these separate information processing components complement each other in the development of these disorders.

Another avenue for future research concerns the causal nature of attentional biases and individual differences in disgust sensitivity. While our studies show that individual differences in disgust sensitivity are associated with an attentional avoidance bias, the directionality of this relationship has yet to be determined. One possibility, as described above, is that individual variation in disgust sensitivity influences the perception of a contamination threat. More disgust sensitive individuals perceive stimuli as more of a contamination threat and will therefore show a stronger avoidant attentional bias. However, this causal relationship could also be reversed. An individual's information processing style could cause a vulnerability to certain stimuli or events (Mathews & MacLeod, 2002). With regard to the current research, it could be that avoiding visual or physical contact with disgust stimuli hampers habituation, ultimately resulting in higher levels of disgust sensitivity. A third possibility is that the relationship between disgust sensitivity and an avoidant attentional bias is bidirectional. Future research could investigate this directionality by, for example, testing whether

individuals' disgust sensitivity is affected by experimental inductions of attentional biases. One way to do this is by means of a modified dot probe task in which participants are trained to either avoid or attend to a disgust stimulus. Research on trait anxiety has shown some evidence that such attentional training tasks using threat-related stimuli affect individuals' trait anxiety after multiple sessions (Amir, Beard, Burns, & Bomyea, 2009; Matthews & MacLeod, 2002), suggesting that information processing strategies can indeed influence one's sensitivity to experience a certain emotion. Another possibility to test the relationship between disgust sensitivity and information processing strategies is by examining attentional biases towards disgust stimuli at several points in time with groups that have naturally occurring changes in disgust sensitivity, such as pregnant women (Fessler, Eng, & Navarrete, 2005).

Conclusion

Disgust sensitivity is associated with various phenomena in the field of social, political, and clinical psychology. One way of improving our understanding of disgust sensitivity's role in these phenomena is by examining the information processing strategies that are associated with individual differences in disgust sensitivity. We therefore tested to what extent individual differences in disgust sensitivity were characterized by 1) a vigilant attentional bias towards disgust stimuli, 2) difficulty disengaging with disgust stimuli, or 3) an avoidant attentional bias of disgust stimuli. While strong evidence is found for the idea that more disgust sensitive individuals display an avoidant attentional bias, this information processing strategy is found for both disgust stimuli as well as negative stimuli. This suggests that high levels of disgust sensitivity are indicative of an oversensitive pathogen threat alert system.

6

Discussion

The aim of this dissertation was to shed more light on the nature of the association between individual differences in disgust sensitivity and moral judgments. To this end, I tested the domain specificity of disgust sensitivity's relationship to moral decision-making and subsequently explored the (psychological) mechanisms underlying this relationship. Additionally, I investigated the information processing styles associated with individual differences in disgust sensitivity to further improve our understanding of this personality trait. In this last chapter, I will outline the main findings of my work and discuss their implications and limitations, as well as ways in which my own studies and future research could address or investigate these issues.

Main Findings

The aim of Chapter 2 was to determine whether disgust sensitivity has a domain-specific or more general relationship with moral decision-making. To this end, we derived three hypotheses from the moral psychology literature. The primarily purity hypothesis predicts that disgust sensitivity is most strongly related to moral judgments in the purity domain, as compared to moral judgments in any of the other moral domains. The primarily binding hypothesis focusses on the distinction between binding (i.e., purity, authority, and loyalty) and individualizing (i.e., care, fairness, and liberty) moral domains and predicts that disgust sensitivity is primarily related to judgments in the binding moral domains. The last hypothesis, the equal strength hypothesis, opposes these domain-specific predictions and proposes that disgust sensitivity relates to moral judgments across all domains equally. We pitted these competing perspectives against each other in five studies and an internal meta-analysis.

Strong evidence was found for the primarily purity hypothesis. Individual differences in disgust sensitivity relate most strongly to moral condemnation of transgressions in the purity

domain. No such consistent and robust link was found between disgust sensitivity and moral judgments in any of the other moral domains. These findings are therefore in line with predictions from pluralistic accounts of morality, such as Moral Foundations Theory (Graham et al., 2013), which argues that some people are more sensitive to a certain set of moral issues, but not to other sets of moral issues.

While supporters of moral pluralism interpret this finding as evidence for the distinctiveness of moral domains, anti-modularity accounts argue that the domain-specific relationship might be caused by factors unrelated to moral content. While I will discuss these factors more elaborately later in this chapter, I will now highlight our main findings regarding the role of pathogen cues, weirdness, and harmfulness. A first factor that might play a role is the presence of pathogen cues in purity transgressions; however, this seems unlikely. We show that adding pathogen cues to other types of transgressions (e.g., a burglar peeing on a carpet) does not increase the strength of their relationship to disgust sensitivity.

A second factor that has been suggested is transgression weirdness (Gray & Keeney, 2015). The general idea is that a sampling bias in the selection of purity transgressions has resulted in purity scenarios that are considerably weirder than scenarios of other moral domains (Gray & Keeney, 2015). In Chapter 3, we investigated the possibility that transgression weirdness accounts for the relationship between disgust sensitivity and moral judgments of the purity domain. Findings show that this is not the case. While purity transgressions are indeed weirder than transgressions of any other moral domain and weirdness is associated with harsher moral judgments, this weirdness cannot account for the stronger relationship between disgust sensitivity and moral judgments of the purity domain.

Chapter 3 was also set up to test the plausibility of perceived harmfulness as an overarching factor explaining morality. One of the most recent monist perspectives on morality, the Theory of Dyadic

Morality, argues that perceptions of harm determine our moral evaluations (Gray, Young et al., 2012; Gray & Schein, 2012). Simply put, if a person perceives more harm in a certain act, it is deemed to be more immoral. Results show that controlling for transgression harmfulness does not affect the relationship between disgust sensitivity and moral judgments of purity. However, perceptions of harm do mediate the relationship between disgust sensitivity and purity moral judgments to some extent, such that more disgust sensitive individuals perceive more harm in purity moral transgressions and subsequently make harsher moral judgments.

In Chapter 4, we flip the perspective and look at the weirdness of items measuring disgust sensitivity. Disgust is often experienced in response to atypical situations or stimuli, and measures of disgust sensitivity reflect this weirdness in their items. It was reasoned that individuals who are more sensitive to weird disgust situations may also be more sensitive to other weird situations, such as the weird transgressions representing the purity domain. In line with this idea, we find that weirdness of disgust sensitivity items is associated with moral judgments of purity, but not care transgressions. Interestingly, eliminating these weird items from disgust sensitivity measures does not affect the tendency for the association between disgust sensitivity and moral judgments to be especially strong for purity transgressions. We therefore concluded that also weirdness of disgust sensitivity items cannot account for the stronger association between disgust sensitivity and moral judgments of purity transgressions, as compared to other types of transgressions.

The aim of Chapter 5 was to further improve our understanding of disgust sensitivity's relationship to moral decision-making by zooming in on disgust sensitivity itself. More specifically, we investigated the information processing biases associated with individual differences in disgust sensitivity in relation to disgust stimuli. Again, three plausible hypotheses were derived from the existing literature, each predicting distinct attentional biases for disgust stimuli with regard to disgust sensitivity. The first two

hypotheses both build on the notion that emotionally salient stimuli tend to attract our attention, but they predict attentional biases at different times. The vigilance hypothesis, on the one hand, concerns the ability of disgust pictures to grab the attention of an individual. It therefore predicts that more disgust sensitive individuals will be more attentive towards disgust stimuli, resulting in a quick detection and continuous monitoring of disgust stimuli. The maintenance hypothesis, on the other hand, argues that disgust sensitive individuals will have difficulty disengaging from disgust stimuli and is thus focused on what happens after detection of a disgust stimulus. More specifically, it predicts that disgust sensitive individuals will dwell longer on disgust stimuli. The third and last hypothesis, the avoidance hypothesis, contradicts predictions from the first two hypotheses. It argues that more disgust sensitive individuals have a more sensitive pathogen threat alerting system and therefore predicts that higher disgust sensitivity will be associated with stronger avoidance of disgust stimuli.

To test these competing hypotheses against each other, we used an eye tracking task to measure eye gazing behaviors continuously over time. Strong support was found for the avoidance hypothesis, while no such support was found for a vigilance and maintenance hypothesis. Individuals high in disgust sensitivity spend less time looking at disgust pictures and return less often to disgust pictures than individuals low in disgust sensitivity. Interestingly, though, this avoidance response associated with disgust sensitivity was not only found for disgust stimuli, but also for other negative stimuli.

The Structure of Morality

Chapters 2 to 4 focus on the relationship between disgust sensitivity and moral judgments, but the findings also have implications for the broader debate on the structure of morality. In

particular, for the distinction between moral monism and moral pluralism. As explained in the Introduction, moral monism is the idea that all morality can be understood by one all-encompassing factor, while moral pluralism argues that morality can be divided into distinct components. The work presented in this dissertation supports a pluralist, but not a monist, account of morality for two reasons. First, we find that disgust sensitivity is more strongly related to moral judgments of one moral domain (i.e., purity) than to moral judgments of other moral domains. Second, this disgust sensitivity-purity relationship cannot be explained by perceptions of harm (i.e., as proposed by one theory of moral monism). Below, I will explain more elaborately why I believe that these findings provide evidence for a pluralist over a monist account of morality.

Disgust Sensitivity-Purity Link

Accounts of moral monism and moral pluralism predict different relationships between disgust sensitivity and moral judgments. Moral monism, on the one hand, refutes the idea that morality can be divided in moral domains and, as such, can only predict domain general processes (e.g., Cameron et al., 2015). According to this view, disgust sensitivity should therefore relate to moral judgments across all domains equally. Moral pluralism, on the other hand, allows for domain specific associations between moral judgments and personality traits (Graham et al., 2013). The personality trait of disgust sensitivity is thought to sensitize people to concerns of the purity domain as these likely result from the same evolutionary problems as disgust. This account would therefore predict that individual differences in disgust sensitivity are more strongly related to moral judgments in the purity domain than to moral judgments in any of the other moral domains.

In Chapter 2, these competing predictions were tested against each other. Across five studies and an internal meta-analysis, we found that disgust sensitivity is more strongly associated with moral judgments of the purity domain than with moral judgments of any

other moral domain (a pattern that was again replicated in Study 3.2 and Study 4.1). This finding is in line with pluralistic accounts of morality and provides direct evidence against moral monism. If all moral domains would be representative of the same construct (i.e., the main argument of moral monism), moral judgments of these domains should also show equivalent relationships to other constructs. Instead, our data show that disgust sensitivity has a consistently stronger relationship to moral judgments of one moral domain (i.e., purity). This domain specific finding highlights the distinctiveness of moral domains and is therefore incompatible with a monist perspective on morality.

Harm as a Mediator

In Chapter 3, we directly tested one prominent theory of moral monism: The Theory of Dyadic Morality. This theory proposes that perceptions of harm are the essence of morality (Gray & Schein, 2012). For the disgust sensitivity-purity association specifically, this would imply that perceptions of harm can account for the stronger relationship between disgust sensitivity and moral judgments of purity. The idea is that more disgust sensitive individuals perceive more harm in purity transgressions than less disgust sensitive individuals, which in turn leads them to make harsher moral judgments of these purity transgressions. Our data only provides partial support for this reasoning. While Study 3.2 shows that transgression harmfulness does indeed mediate the relationship between disgust sensitivity and moral judgments of purity, it does not support the idea that taking transgression harmfulness into account eliminates the interaction effect of disgust sensitivity and moral domain on moral judgments (without harmfulness: $b = 0.71$, $SE = 0.13$, $p < .001$, with harmfulness: $b = 0.27$, $SE = 0.09$, $p = .003$). Disgust sensitivity is more strongly related to moral judgments of purity, as compared to other types of transgressions, even when taking into account the mediating effect of transgression harmfulness.

Adding harmfulness as a mediator did diminish the interaction effect of disgust sensitivity and moral domain considerably ($z = 2.72$, $p = .007$). It could therefore be argued that the Theory of Dyadic Harm is largely supported by our data. However, the central premise of the Theory of Dyadic Morality is not that harmfulness is simply associated with perceptions of morality, but that "all morality is understood through the lens of harm" (Gray, Young et al., 2012, p. 108). This is not what we find. Our data show that perceived harmfulness can only partially account for the relationship between disgust sensitivity and purity moral judgments. The data also show that perceptions of harm are important to morality (at least in our Western samples), however, this finding is neither new nor controversial (e.g., Haidt, Koller, & Dias, 1993; Hofmann et al., 2014). However, accepting this partial explanation of the disgust sensitivity-purity link by harmfulness as evidence for dyadic morality would imply discarding the theory's most defining proposition: That harmfulness is the *single* factor underlying morality. It can therefore be concluded that while the Theory of Dyadic Morality provides an attractive parsimonious solution for morality, our data shows that it lacks the explanatory power to account for the link between disgust sensitivity and moral judgments of purity transgressions (see Haidt, Graham, & Ditto, 2015a and 2015b for a further discussion on the explanatory power of Dyadic Morality).[21]

[21] Dyadic Morality was introduced as a monist account of morality (e.g., Gray, Young et al., 2012), but later it was argued that Dyadic Morality advocates harm pluralism, proposing that "different moral content such as purity and loyalty are (less prototypical) varieties of perceived harm" (Schein & Gray, 2015, p. 1150). However, this "pluralistic" version of Dyadic Morality not only keeps its main argument of a monist nature (i.e., that all morality can be reduced to perceived harm), it also merely rephrases the question that needs to be answered in order to understand morality (i.e., from "what predicts moral judgments of domains?" to "what predicts harmfulness of domains?"). And it appears that pluralistic accounts are better equipped to do that.

Moral Purity

The moral domain of purity is originally thought of as an evolutionary adaption against coming into contact with pathogens, parasites, or other contamination threats (Haidt, 2012). It therefore includes beliefs about physical purity, but also extends to concerns about spiritual purity. However, there is some debate about what exactly constitutes the purity domain and whether it even exists. One point of concern is that there is a bias in the selection of purity transgressions, resulting in transgressions that are not only weird, but that also often include direct references to pathogen cues (Gray & Keeney, 2015; Kayyal, Pochedly, McCarthy, & Russell, 2015; Piazza, Landy, Chakroff, Young, & Wasserman, in press; Royzman, Atanasov, Landy, Parks, & Gepty, 2014). This raises two questions. First, is the stronger relationship between disgust sensitivity's and purity moral judgments primarily due to factors that are not related to morality (i.e., pathogen cues and weirdness)? And second, what features, other than pathogen cues or weirdness, define purity transgressions? In other words, it calls for an explanation of what makes purity transgressions distinct from other moral transgressions.

Both issues will be discussed in the following sections by considering the implications of pathogen cues in purity transgressions and usage of weird purity transgressions with regard to the research presented in this dissertation. Subsequently, I will describe what characterizes purity transgressions, other than their weirdness and the presence of pathogen cues. And finally, I will address the debate on the existence of a moral purity domain.

Pathogens in Purity Transgressions

Moral purity is closely tied to concerns about physical contamination (Haidt, 2012). It is therefore not surprising that many transgressions representing the purity domain include references to core disgust elicitors, either directly or via behaviors that are

associated with contamination (e.g., sexual acts). While this is not necessarily a problematic feature for other research on moral purity, it is a potential confound when investigating disgust sensitivity's role in moral decision-making. Therefore we directly tested whether the presence of a pathogen cue in a moral transgressions was sufficient to establish an association between moral judgments of these transgressions and disgust sensitivity in Chapter 2. We reasoned that if the relationship between moral judgments of purity transgressions and disgust sensitivity is based solely on the presence of pathogen cues, then adding such a cue to other types of moral transgressions should result in a similarly strong relationship with disgust sensitivity. This is not what we find. The presence of pathogen cues in moral transgressions of non-purity domains (i.e., care, fairness, and loyalty) did not strengthen the association between moral judgments of these transgressions and disgust sensitivity. It therefore seems unlikely that disgust sensitivity's stronger relationship to moral judgments of purity transgressions can only be attributed to the presence of pathogen cues in purity transgressions. This fits with a theory recently put forward by Rottman and colleagues, that there is more to the origin of disgust than pathogen avoidance alone and that the socio-moral component may be more important than previously assumed (Rottman, DeJesus, & Gerdin, in press).

Weirdness of Purity Transgressions

Purity transgressions are considerably weirder than transgressions of the care domain (Chakroff & Young, 2015a; Gray & Keeney, 2015), which might be the result of a sampling bias. There are two ways in which this weirdness might play a role in disgust sensitivity's stronger relationship to moral judgments of purity transgressions. First, it could be that individuals who are more easily disgusted are more sensitive to any kind of deviation from what is normal, and thus also to these weird or bizarre scenarios representing the purity domain. Second, weirdness might be a shared characteristic of measures tapping into disgust sensitivity and moral purity.

In this dissertation, I tested both explanations, but come to the conclusion that there is little reason to assume that weirdness explains why disgust sensitivity is more strongly related to moral judgments of purity, as compared to other types of, transgressions. This conclusion is based on three pieces of evidence. First, individual differences in disgust sensitivity are unrelated to a general sensitivity to deviation (Study 2.4), showing that more disgust sensitive individuals are not necessarily more sensitive to any type of deviation. Second, transgression weirdness cannot account for the interaction effect of disgust sensitivity and moral domain on moral judgments (Study 3.1 and Study 3.2). While we do find that disgust sensitive individuals perceive purity transgressions to be weirder than less disgust sensitive individuals, we also find that this is not specific to the purity domain. Any kind of moral transgression, purity and non-purity, is perceived to be weirder by disgust sensitive individuals, which is why weirdness cannot account for the stronger relationship between disgust sensitivity and moral transgressions of the purity domain, as compared to other moral domains. Third, the overlap in weirdness in measures of disgust sensitivity and moral purity cannot explain the disgust sensitivity-purity link. Study 4.1 showed that weirdness of disgust sensitivity items was associated with moral judgments of purity transgressions, however, there was no evidence that the inclusion of weird disgust sensitivity items explains the interaction between disgust sensitivity and moral domain. I therefore agree with the notion that purity transgressions are weirder than other types of transgressions (a finding replicated in Study 3.1 and Study 3.2), but this weirdness does not explain the finding that disgust sensitivity is more strongly related to purity moral judgments.

What Characterizes Purity Transgressions?

As described above, purity transgressions are often characterized by weirdness and the presence of pathogen cues. However, research has found other ways in which transgressions of the purity domain systematically differ from other types of transgressions (especially

harmful transgressions). In line with the idea that the purity domain serves to protect *the self* against contamination, research has found that purity transgressions are typically self-directed and have no clear victim other than the self (Chakroff, Dungan, & Young, 2013). Additionally, a transgressor's intent is found to be less relevant to moral judgments of impure as compared to harmful transgressions (Chakroff et al., 2016; Young & Saxe, 2011; also see Chakroff & Young, 2015b), which is likely due to the belief that physical or spiritual contamination occurs regardless of an individual's intentionality. Harmful and impure transgressions also lead to different attributions. Impure transgressions lead to stronger inferences about the transgressor's moral character, while harmful transgressions are attributed to situational factors (Chakroff & Young, 2015a; Sabo & Giner-Sorolla, 2017; Uhlmann & Zhu, 2013). They can be further distinguished by the facial expressions they elicit, with transgressions of the care domain evoking a facial expression similar to anger (i.e., activation in the corrugator supercilii) and purity transgressions evoking a facial expression similar to disgust (i.e., activation in the levator labii; Cannon et al., 2011). Lastly, while moral transgressions of the purity and care/harm domains activate overlapping brain areas, purity transgressions typically elicit more activation in brain systems associated with affect (Borg et al., 2008; Parkinson et al., 2011). Together, these studies show several ways in which the purity domain can be meaningfully distinguished from other moral domains. In sum, purity transgressions are 1) self-directed acts, 2) reveal something about the transgressor's moral character, 3) emotionally arousing (i.e., especially disgust), and 4) moral judgments of purity transgressions are less dependent on situational factors.

Purity as a Moral Domain?

While the previous paragraph illustrates the many ways in which purity transgressions can be distinguished from other types of moral transgressions, some researchers are not convinced that the

purity domain has a clearly distinct *moral* component, leading them to dispute the notion of purity as a meaningful moral domain (e.g., Gray & Keeney, 2015; Gray, Young et al., 2012). However, advocates of Moral Foundations Theory argue that this argument is grounded in a Western (i.e., liberal) perspective and does not incorporate more traditional cultures (Graham et al., in press; Haidt & Joseph, 2004; Koleva & Haidt, 2012; Shweder et al., 1997). In line with this reasoning, research has shown that the purity domain is more strongly endorsed by conservatives than liberals (Graham et al., 2009). The importance of purity concerns may not be immediately evident in liberal societies, but this in itself does not imply that purity is not a meaningful moral domain.

In many traditional or religious cultures, purity concerns are prominently present in everyday life and individuals in these cultures typically have strong beliefs related to purity (Shweder et al., 1997). This is not only reflected in norms about physical purity, such as practices revolving around eating, death, child birth, and marriage, but many religions also promote spiritual purification. Meditation, refraining from watching pornography or engaging in sexually promiscuous behaviors, baptism, oblations (i.e., offerings), resisting lustful or other evil thoughts, confessing one's sins, and avoiding contact with members of other castes are all examples of moral norms that are followed for purity reasons. While for many individuals in Western societies the concept of purity is not based on religious considerations, some behaviors or ideas are rejected because they are perceived as violating some unseen natural order or as going against nature. For example, disapproval of issues such as abortion, same-sex marriage, genetically modified foods, animal biotechnology, and euthanasia can all be linked to purity concerns (Koleva et al., 2012; Pivetti, 2007; Tenbült, De Vries, Dreezens, & Martijn, 2005). While the purity domain is thus strongly endorsed in religious and traditional cultures, purity concerns are also still relevant in many Western and liberal societies, albeit to a lesser extent.

Although this indicates that purity concerns can be important to individuals, it does not necessarily show that these norms are moralized. Whether that is the case depends largely on how one defines moral norms. Several requirements have been proposed for norms to be considered moral. Some commonly used criteria are that 1) they should be applied equally across individuals or contexts (i.e., universally; Hare, 1981), 2) evaluating transgressions of moral norms should be accompanied by an emotional reaction (Bicchieri, 2006; Nichols, 2004; Prinz, 2006), and 3) witnessing transgressions of moral norms should evoke an action motivation (Mackie, 1982; Prinz, 2006). There are indications that the latter two criteria of morality are met by the purity domain. Purity transgressions elicit disgust (e.g., Rozin, Lowery et al., 1999; Russell & Giner-Sorolla, 2013), and people distance themselves from individuals with different purity beliefs or transgressors of purity norms (Dehghani et al., 2016; Kemper & Newheiser, 2017). It is less clear though to what extent purity norms live up to the first criterion. While many religions seem to apply purity norms universally (e.g., purity is always a prerequisite for going to heaven/Indralok/Jannah), there are, to my knowledge, no studies systematically testing whether individuals apply purity norms equally across persons and contexts. Most research investigating purity moral judgments, including my own, uses designs with an unidentified other person. Future research could directly test whether purity norms are universally applied by comparing moral judgments of purity transgressions conducted by perpetrators with different identities (e.g., on relational closeness; see Skitka, Bauman, & Sargis, 2005). If purity norms are moral, then individuals who strongly endorse such purity norms should not distinguish between these perpetrators with regard to their moral judgments.

It should be noted that these three requirements are by no means the only three criteria proposed to distinguish conventional from moral norms. Researchers have argued that several other factors play a role, such as feelings of guilt (Elster, 2009) or the contingency on rules or authority (Nucci, 1986; Turiel, 2008). Future research

could therefore evaluate the moral potential of purity more broadly and also compare this evaluation with well-established forms of morality (e.g., harm).

Disgust Sensitivity

Disgust is experienced across cultures, but there is considerable individual variation in the sensitivity to disgust. This variability is called disgust sensitivity and it has been related to many psychological constructs (e.g., moral decision-making, political ideology, disorders). In Chapter 5, we looked at the information processing biases associated with individual differences in disgust sensitivity by means of eye tracking methodology. More specifically, it was tested whether individuals high and low in disgust sensitivity have different attentional biases when encountering disgust stimuli. While some perspectives predict that emotionally salient stimuli attract attention, we find that more disgust sensitive individuals show a stronger avoidant attentional bias towards disgust stimuli (i.e., the stimuli that are emotionally salient to them). However, Study 5.2 shows that individual differences in disgust sensitivity not only predict visual avoidance of disgust stimuli, but also of other negative stimuli. This goes against the idea that disgust sensitivity reflects a sensitivity to disgusting stimuli specifically, and suggests that it might be indicative of a more general sensitivity towards negative stimuli. Indeed, our data showed that more disgust sensitive individuals not only perceived disgust stimuli to be more disgusting, but they also perceived general negative stimuli to be more disgusting than less disgust sensitive individuals. This would be in line with the idea that disgust sensitive individuals have a more sensitive pathogen threat alerting system, which might alert them to a contamination threat even when, objectively, no pathogens are present.

The findings of Chapter 5 might also help explain the disgust sensitivity-purity link found in the Chapters 2 to 4. It may be the case

that disgust sensitive individuals react with stronger moral condemnation to purity transgressions because they perceive them to be more of contamination threat than less disgust sensitive individuals. This prediction of contamination perception as a mediator of the disgust sensitivity-purity link should be tested in future research. However, the finding that individual differences in disgust sensitivity are not only predictive of an individual's avoidant attentional bias of disgust stimuli, but also of negative stimuli is more difficult to interpret with regard to disgust sensitivity's relationship to moral judgments. This finding would be more in line with a domain general association between disgust sensitivity and moral judgments as it shows that disgust sensitivity's rejection impulse is equally strong for stimuli that elicit disgust and other negative stimuli. However, this domain general hypothesis is not supported by our data. In all our studies, disgust sensitivity is primarily related to moral judgments of only one domain: Purity. This suggests that the information processing styles associated with individual differences in disgust sensitivity are not directly reflected in moral decision-making, but future research could more directly test this possibility.

Trait and State Disgust

The work presented in Chapters 2, 3, and 4 of this dissertation demonstrates that individual differences in disgust sensitivity have a consistently stronger relationship to moral judgments of purity transgressions. This finding may seem in contrast to the conclusion drawn in the Introduction that there is little evidence that inductions of disgust amplify moral judgments. However, the reasoning behind state and trait disgust's association to moral judgments differ in important ways. Most research investigating the amplification effect of disgust on moral condemnation induced incidental feelings of disgust (e.g., Eskine et al., 2011; Schnall, Haidt et al., 2008). However, moral values are thought to be deeply held beliefs about what is right and wrong and are therefore unlikely to change due to a single experience of disgust,

especially when this disgust does not come from the moral transgression at hand.

Trait disgust (i.e., disgust sensitivity), on the contrary, corresponds more directly with moral cognition. Personality traits and moral intuitions are thought to be based on a combination of innate psychological mechanisms and culture (Richerson & Boyd, 2005). The innate mechanisms and cultural factors that shape an individual's disgust sensitivity and concern about moral purity are likely to be the same for a large part, as both disgust sensitivity and moral purity can be traced back to a motivation to stay clear of physical and mental contamination. Contrary to state disgust, trait disgust therefore does not merely influence our moral judgments. Instead, trait disgust and moral purity concerns might be two products of the same basic developmental process.

However, it should be noted that based on the studies presented in this dissertation, no claims can be made about the directionality of the relationship between disgust sensitivity and moral judgments of purity. All my studies used cross-sectional designs and can therefore not provide insights into the causal nature of this relationship. While we originally thought that manipulating state disgust would be a promising way to investigate the causal impact on moral judgments, it seems that such manipulations do not affect moral decision-making (Landy & Goodwin, 2015; also see Introduction). However, there are some ways in which the causal relationship between disgust sensitivity and moral judgments of purity can be tested more directly. As described in Chapter 5, some groups have naturally occurring changes in disgust sensitivity (e.g., pregnant women) and one could examine whether moral judgments of purity transgressions follow these changes.

To conclude, our findings outline the role of disgust sensitivity in moral decision-making. Comparing the strength of disgust sensitivity's association to distinct moral domains revealed a particularly strong relationship with moral judgments of the purity domain. While this finding contributes to our understanding of the

role of disgust sensitivity in morality, the differential association also speaks to the broader debate on the dimensional structure of morality, as it highlights the distinctiveness of the purity domain

References

Aharoni, R., & Hertz, M. M. (2011). Disgust sensitivity and anorexia nervosa. *European Eating Disorders Review, 20,* 106-110. https://dx.doi.org/10.1002/erv.1124

Allport, G. W. (1954). *The nature of prejudice.* Cambridge, MA: Addison-Wesley.

Amir, N., Beard, C., Burns, M., & Bomyea, J. (2009). Attention modification program in individuals with generalized anxiety disorder. *Journal of Abnormal Psychology, 118,* 28-33. https://dx.doi.org/10.1037/a0012589

Amir, N., Elias, J., Klumpp, H., & Przeworski, A. (2003). Attentional bias to threat in social phobia: Facilitated processing of threat or difficulty engaging attention from threat? *Behaviour Research and Therapy, 41,* 1325-1335. https://dx.doi.org/10.1016/S0005-7967(03)00039-1

Asmundson, G. J. G., & Stein, M. B. (1994). Selective processing of social threat in patients with generalized social phobia: Evaluation using a dot-probe paradigm. *Journal of Anxiety Disorders*, *8*, 107–117. https://dx.doi.org/10.1016/0887-6185(94)90009-4

Barbour, K. A., Eckhardt, C. I., Davison, G. C., & Kassinove, H. (1998). The experience and expression of anger in maritally violent and nonviolent men. *Behavior Therapy, 29,* 173-191. https://dx.doi.org/10.1016/S0005-7894(98)80001-4

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software, 67,* 1-48. https://dx.doi.org/10.18637/ jss. v067. i01

References

Baumard, N., & André, J. B., & Sperber, D. (2013). A mutualistic approach to morality: The evolution of fairness by partner choice. *Behavioral and Brain Sciences, 36,* 59-78. https://dx.doi.org/10.1017/S0140525X11002202

Bicchieri, C. (2006). *The Grammar of Society: The Nature and Dynamics of Social Norms*. New York: Cambridge University Press.

Borg, J. S., Lieberman, D., & Kiehl, K. A. (2008). Infection, incest, & iniquity: Investigating the neural correlates of disgust and morality. *Journal of Cognitive Neuroscience, 20*, 1529- 1546. https://dx.doi.org/10.1162/jocn.2008.20109

Bradley, B. P., Mogg, K., Falla, S. J., & Hamilton, L. R. (1998). Attentional bias for threatening facial expressions in anxiety: Manipulation of stimulus duration. *Cognition and Emotion, 12,* 737-753. https://dx.doi.org/10.1080/026999398379411

Bradley, B. P., Mogg, K., White, J., Groom, C., & De Bono, J. (1999). Attentional bias for emotional faces in generalized anxiety disorder. *Clinical Psychology, 38,* 267-278. https://dx.doi.org/10.1348/014466599162845

Brandt, M. J., & Reyna, C. (2011). The chain of being: A hierarchy of morality. *Perspectives on Psychological Science, 6*, 428-466. https://dx.doi.org/10.1177/1745691611414587

Brenner, C. J., & Inbar, Y. (2014). Disgust sensitivity predicts political ideology and policy attitudes in the Netherlands. *European Journal of Social Psychology, 45,* 27-38. https://dx.doi.org/10.1002/ejsp.2072

Cameron, C. D., Lindquist, K. A., & Gray, K. (2015). A constructionist review of morality and emotions: No evidence for specific correspondences between discrete emotions and moral concerns. *Personality and Social Psychology Review, 19,* 371-394. https://dx.doi.org/10.1177/1088868314566683

Cannon, P. R., Schnall, S., & White, M. (2011). Transgressions and expressions: Affective facial muscle activity predicts moral judgments. *Social Psychological and Personality Science, 2,* 325-331. https://dx.doi.org/10.1177/1948550610390525

Caseras, X., Garner, M., Bradley, B. P., & Mogg, K. (2007). Biases in visual orienting to negative and positive scenes in dysphoria: An eye movement study. *Journal of Abnormal Psychology, 116,* 491-497. https://dx.doi.org/10.1037/0021-843X. 116. 3.491

Chakroff, A., Dungan, J., Koster-Hale, J., Brown, A., Saxe, R., & Young, L. (2016). When minds matter for moral judgment: Intent information is neutrally encoded for harmful but not impure acts. *Social Cognitive and Affective Neuroscience, 11,* 476-484. https://dx.doi.org/10.1093/scan/nsv131

Chakroff, A., Dungan, J. & Young, L. (2013). Harming ourselves and defiling others: What determines a moral domain? *PLOS ONE, 8*: e74434. https://dx.doi.org/10.1371/journal.pone. 0074434

Chakroff, A., & Young, L. (2015a). Harmful situations, impure people: An attribution asymmetry across moral domains. *Cognition, 136*, 30-37. https://dx.doi.org/10.1016/j.cognition.2014.11. 034

Chakroff, A., & Young, L. (2015b). How the mind matters for morality. *AJOB Neuroscience, 6,* 41-46. https://dx.doi.org/10. 1080/21507740.2015.1058866

Chapman, H. A., & Anderson, A. K. (2014). Trait physical disgust is related to moral judgments outside of the purity domain. *Emotion, 14*, 341-348. https://dx.doi.org/10.1037/a0035120

References

Chapman, H. A., Kim, D. A., Susskind, J. M., & Anderson, A. K. (2009). In bad taste: Evidence for the oral origins of moral disgust. *Science, 5918,* 1222-1226. https://dx.doi.org/10.1126/science.1165565

Ghelfi, E., Christopherson, C., Fischer, M. A., Guberman, J., Legate, N., Lenne R.,…Turpin, R. (in preparation). A large scale replication of Eskine, Kacinik, & Prinz, (2011). A bad taste in the mouth: Gustatory disgust influences moral judgments.

Ciaramelli, E., Muccioli, M., Làdavas, E., & Di Pellegrino, G. (2007). Selective deficit in personal moral judgment following damage to ventromedial prefrontal cortex. *Social Cognitive and Affective Neuroscience, 2,* 84-92. https://dx.doi.org/10.1093/scan/nsm001

Cisler, J. M., Olatunji, B. O., Lohr, J. M., & Williams, N. L. (2009). Attentional bias differences between fear and disgust: Implications for the role of disgust in disgust-related anxiety disorders. *Cognition and Emotion, 23,* 675-687. https://dx.doi.org/10.1080/ 02699930802051599

Clifford, S., Iyengar, V., Cabeza, R., & Sinnott-Armstrong, W. (2015). Moral foundations vignettes: A standardized stimulus database of scenarios based on moral foundations theory. *Behavior Research Methods, 47*, 1178-1198. https://dx.doi.org/10.3758/s13428-014-0551-2

Clore, G. L., & Palmer, J. E. (2009). Affective guidance of intelligent agents: How emotion controls cognition. *Cognitive Systems Research, 10,* 21-30. https://dx.doi.org/10.1016/j.cogsys.2008.03.002

Crawford, J., Inbar, Y., & Maloney, V. (2014). Disgust sensitivity selectively predicts attitudes towards groups that threaten (or uphold) traditional sexual morality. *Personality and Individual Differences, 70,* 218-223. https://dx.doi.org/10.1016/j.paid.2014.07.001

Crimston, D., Bain, P. G., Hornsey, M. J., & Bastian, B. (2016). Moral expansiveness: Examining variability in the extension of the moral world. *Journal of Personality and Social Psychology, 111,* 636-653. https://dx.doi.org/10.1037/pspp0000086

Curtis, V. (2013). *Don't look, don't touch, the science behind revulsion.* Oxford: Oxford University Press.

Curtis, V., Aunger, R., & Rabie, T. (2004). Evidence that disgust evolved to protect from risk of disease. *Proceedings of the Royal Society of London, Series B, 271,* S131-S133. https://dx.doi.org/10.1098/rsbl.2003.0144

Curtis V., & Biran, A. (2001). Dirt, disgust, and disease: Is hygiene in our genes? *Perspectives in Biology and Medicine, 44,* 17-31. https://dx.doi.org/10.1353/pbm.2001.0001

Cushman, F. A., Young, L., & Hauser, M. D. (2006). The Role of Conscious Reasoning and Intuition in Moral Judgments: Testing three principles of harm. *Psychological Science 17*, 1082-1089. https://dx.doi.org/10.1111/j.1467-9280.2006.01834.x

Darwin, C. (1872). *The expression of the emotions in man and animals.* London: John Murray. https://dx.doi.org/10.1037/10001-000

Davey, G. C. L., Buckland, G., Tantow, B., & Dallos, R. (1998). Disgust and eating disorders. *European Eating Disorders Review, 6,* 201-211. https://dx.doi.org/10.1002/(SICI)1099-0968(199809)6:3<201::AID-ERV224>3.0.CO;2-E

References

Deacon, B., & Olatunji, B. O. (2007). Specificity of disgust sensitivity in the prediction of behavioral avoidance in contamination fear. *Behaviour Research and Therapy, 45,* 2110-2120. https://dx.doi.org/10.1016/j.brat.2007.03.008

Dehghani, M., Johnson, K., Hoover, J., Sagi, E., Garten, J., Parmar, N. J., … Graham, J. (2016). Purity homophily in social networks. *Journal of Experimental Psychology: General, 145,* 366-375. https://dx.doi.org/10.1037/xge0000139

De Jong, P. J., & Merckelbach, H. (1998). Blood-injection-injury phobia and fear of spiders: Domain specific individual differences in disgust sensitivity. *Personality and Individual Differences, 24,* 153–158. https://dx.doi.org/10.1016/S0191-8869(97)00178-5

De Jong, P. J., Peters, M., & Vanderhallen, I. (2002). Disgust and disgust sensitivity in spider phobia: Faial EMG in response to spider and oral disgust imagery. *Journal of Anxiety Disorders, 16,* 477-493. https://dx.doi.org/10.1016/S0887-6185(02)00167-6

Druschel, B. A., & Sherman, M. F. (1999). Disgust sensitivity as a function of the Big Five and gender. *Personality and Individual Differences, 26*, 739-748. https://dx.doi.org/10.1016/S01918869(98)00196-2

Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease: Development and validation of a 15-item self-report instrument. *Personality and Individual Differences, 47,* 541-546. https://dx.doi.org/10.1016/j.paid.2009.05.001

Dutton, D. G., & Aron, A. P. (1974). Some evidence for heightened sexual attraction under conditions of high anxiety. *Journal of Personality and Social Psychology, 30,* 510-517. https://dx.doi.org/10.1037/h0037031

Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion, 6,* 169-200. https://dx.doi.org/10.1080/02699939208411068

Elster, J. (2009). Social norms and the explanation of behavior. In P. Hedström & P. Bearman (Eds.), *The oxford handbook of analytical sociology* (pp. 195–217). Oxford: Oxford University Press.

Eskine, K. J., Kacinik, N. A., & Prinz, J. J. (2011). A bad taste in the mouth: Gustatory disgust influences moral judgments. *Psychological Science, 22,* 295-299. https://dx.doi.org/10.1177/0956797611398497

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191. https://dx.doi.org/10.3758/BF03193146

Fessler, D. M. T., Eng, S. J., & Navarrete, C. D. (2005). Elevated disgust sensitivity in the first trimester of pregnancy: Evidence supporting the compensatory prophylaxis hypothesis. *Evolution and Human Behavior, 26,* 344-351. https://dx.doi.org/10.1016/ j.evolhumbehav.2004.12.001

Fiske, A. P. (2002). Socio-moral emotions motivate action to sustain relationships. *Self and Identity, 1,* 169-175. https://dx.doi/org/10.1080/152988602317319357

Forgays, D. G., Forgays, D. K., & Spielberger, C. D. (1997). Factor structure of the State-Trait Anger Expression Inventory. *Journal of Personality Assessment, 69,* 497-507. https://dx.doi.org/10.1207/s15327752jpa6903_5

Fox, E. (1993). Allocation of visual attention and anxiety. *Cognition and Emotion, 7,* 207-215. https://dx.doi.org/10.1080/02699939308409185

References

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do threatening stimuli draw or hold visual attention in subclinical anxiety? *Journal of Experimental Psychology: General, 130,* 681-700. https://dx.doi.org/10.1037/0096-3445.130.5.681

Fox, E., Russo, R., & Dutton, K. (2002). Attentional bias for threat: Evidence for delayed disengagement from emotional faces. *Cognition and Emotion, 16,* 355-379. https://dx.doi.org/10.1080/02699930143000527

Frank, R. H. (2001). Cooperation through emotional commitment. In R. M. Nesse (Ed.), *Vol. 3 in the Russell Sage Foundation series on trust. Evolution and the capacity for commitment* (pp. 57-76). New York: Russell Sage Foundation.

Gamer, M., Lemon, J., Fellows, I., & Sing, P. (2012). irr: Various coefficients of interrater reliability and agreement (Version 0.84) [Computer software]. Retrieved from https://CRAN.R-project.org/package=irr

Garvey, K. J., & Ford, T. G. (2014). Rationality, political orientation, and the individualizing and binding moral foundations. *Letters on Evolutionary Behavioral Science, 5*, 9-12. https://dx.doi.org/10.5178/lebs.2014.2910.5178/lebs.2014.29

Gilligan, C., & Wiggins, G. (1988). The origins of morality in early childhood relationships. In C. Gilligan, J. V. Ward, J. M. Taylor, & B. Bardige (Eds.), *Mapping the moral domain: A contribution of women's thinking to psychological theory and education* (pp. 111-138). Cambridge, MA: Harvard University Press. https://dx.doi.org/10.1097/00005053-199107000-00016

Giner-Sorolla, R., & Chapman, H. (2016). Beyond purity: Moral disgust toward bad character. *Psychological Science, 28,* 80-91. https://dx.doi.org/10.1177/ 0956797616673193

Graham, J., Haidt, J., Koleva, S., Motyl, M., Iyer, R., Wojcik, S., & Ditto, P. H. (2013). Moral Foundations Theory: The pragmatic validity of moral pluralism. *Advances in Experimental Social Psychology, 47,* 55-130. https://dx.doi.org/10.1016/B978-0-12-407236-7.00002-4

Graham, J., Haidt, J., Motyl, M., Meindl, P., Iskiwitch, C., & Mooijman, M. (in press). On the advantages of moral pluralism over moral monism. In K. Gray & J. Graham (Eds.), *The Atlas of Moral Psychology: Mapping Good and Evil in the Mind.* New York: Guilford.

Graham, J., Haidt, J., & Nosek, B. A. (2009). Liberals and conservatives rely on different sets of moral foundations. *Journal of Personality and Social Psychology, 96,* 1029-1046. https://dx.doi.org/10.1037/a0015141

Graham, J., Nosek, B. A., Haidt, J., Iyer, R., Koleva, S., & Ditto, P. H. (2011). Mapping the moral domain. *Journal of Personality and Social Psychology, 101,* 366-385. https://dx.doi.org/10.1037/a0021847

Gray, K., & Keeney, J. E. (2015). Impure, or just weird? Scenario sampling bias raises questions about the foundation of morality. *Social Psychological and Personality Science, 6*, 859-868. https://dx.doi.org/10.1177/1948550615592241

Gray, K. & Schein, C. (2012). Two minds vs. two philosophies: Mind perception defines morality and dissolves the debate between deontology and utilitarianism. *Review of Philosophy and Psychology*, 3, 405-423. https://dx.doi.org/10.1007/s13164-012-0112-5

Gray, K., Waytz, A., & Young, L. (2012). The moral dyad: A fundamental template unifying moral judgment. *Psychological Inquiry, 23,* 206-215. https://dx.doi.org/10.1080/1047840X.2012.686247

References

Gray, K., & Wegner, D. M. (2011). Morality takes two: Dyadic morality and mind perception. In P. Shaver & M. Mikulincer (Eds.), *The Social Psychology of Morality*. Washington DC: APA Press.

Gray, K., Young, L., & Waytz, A. (2012). Mind perception is the essence of morality. *Psychological Inquiry, 23*, 101-124. https://dx.doi.org/10.1080/1047840X.2012.651387

Greene, J. D. (2014). The cognitive neuroscience of moral judgment and decision-making. In M. S. Gazzaniga & G. R. Mangun (Eds.), *The Cognitive Neurosciences V*. Cambridge, MA: MIT Press.

Gutierrez, R., & Giner-Sorolla, R. (2007). Anger, disgust, and presumption of harm as reactions to taboo-breaking behaviors. *Emotion, 7,* 853-868. https://dx.doi.org/10.1037/1528-3542.7.4.853

Haidt, J. (2001). The emotional dog and its rational tail: A social intuitionist approach to moral judgment. *Psychological Review, 108*, 814-834. https://dx.doi.org/10.1037//0033-295X.108.4.814

Haidt, J. (2008). Morality. *Perspectives on Psychological Science, 3*, 65-72. https://dx.doi.org/10.1111/j.1745-6916.2008.00063.x

Haidt, J. (2012). *The righteous mind: Why good people are divided by politics and religion.* New York: Pantheon.

Haidt, J., & Graham, J. (2007). When morality opposes justice: Conservatives have moral intuitions that liberals may not recognize. *Social Justice Research, 20*, 98-116. https://dx.doi.org/10.1007/s11211-007-0034-z

Haidt, J., Graham, J., & Ditto, P. H. (2015a). A straw man can never beat a shapeshifter: Response to Schein and Gray (2015). Retrieved from http://www.yourmorals.org/blog/2015/10/a-straw-man-can-never-beat-a-shapeshifter/

Haidt, J., Graham, J., & Ditto, P. H. (2015b). Dyadic morality is the Volkswagen of moral psychology. Retrieved from http://www.spsp.org/news-center/blog/volkswagen-of-morality

Haidt, J., & Joseph, C. (2004). Intuitive ethics: How innately prepared intuitions generate culturally variable virtues. *Daedalus, 133,* 55-66. https://dx.doi.org/10.1162/0011526042365555

Haidt, J., & Joseph, C. (2007). The moral mind: How 5 sets of innate moral intuitions guide the development of many culture-specific virtues, and perhaps even modules. In P. Carruthers, S. Laurence, & S. Stich (Eds.) *The Innate Mind, Vol. 3* (pp. 367-391). New York: Oxford. https://dx.doi.org/10.1093/acprof:oso/9780195332834.001.0001

Haidt, J., & Kesebir, S. (2010). Morality. In S. Fiske, D. Gilbert, & G. Lindzey (Eds.) *Handbook of Social Psychology, 5th Edition* (pp. 797-832). Hobeken, NJ: Wiley. https://dx.doi.org/10.1002/9780470561119

Haidt, J., Koller, S. H., & Dias, M. G. (1993). Affect, culture, and morality, or is it wrong to eat your dog? *Journal of Personality and Social Psychology, 65*, 613-628. https://dx.doi.org/10.1037/0022-3514.65.4.613

Haidt, J., McCauley, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences, 16*, 701-713. https://dx.doi.org/10.1016/0191-8869(94)90212-7

Haidt, J., Rozin, P., McCauley, C., & Imada, S. (1997). Body, psyche, and culture: The relationship of disgust to morality. *Psychology and Developing Societies, 9*, 107-131. https://dx.doi.org/10.1177/097133369700900105

References

Hare, R. M. (1981). *Moral thinking: Its levels, method, and point*. New York: Oxford University Press.

Harlé, K. M., & Sanfey, A. G. (2010). Effects of approach and withdrawal motivation on interactive economic decisions. *Cognition & Emotion, 24*, 1456–1465. https://dx.doi.org/10.1080/02699930903510220

Harris, S. (2010). *The moral landscape: How science can determine human values*. New York: Free Press.

Haselton, M. G., & Nettle, D. (2006). The paranoid optimist: An integrative evolutionary model of cognitive biases. *Personality and Social Psychology Review, 10,* 47-66. https://dx.doi.org/10.1207/s15327957pspr1001_3

Hodson, G., & Costello, K. (2007). Interpersonal disgust, ideological orientations, and dehumanization as predictors of intergroup attitudes. *Psychological Science, 18*, 691-698. https://dx.doi.org/10.1111/j.1467-9280.2007.01962.x

Hofmann, W., Wisneski, D. C., Brandt, M. J., & Skitka, L. J. (2014). Morality in everyday life. *Science, 345,* 1340-1343. https://dx.doi.org/10.1126/science.1251560

Horberg, E. J., Oveis, C., & Keltner, D. (2011). Emotions as moral amplifiers: An appraisal tendency approach to the influences of distinct emotions upon moral judgment. *Emotion Review, 3*, 237-244. https://dx.doi.org/10.1177/1754073911402384

Horberg, E. J., Oveis, C., Keltner, D., & Cohen, A. B. (2009). Disgust and the moralization of purity. *Journal of Personality and Social Psychology, 97,* 963–976. https://dx.doi.org/10.1037/a0017423

Huebner, B., Dwyer, S., & Hauser, M. (2009). The role of emotion in moral psychology. *Trends in Cognitive Sciences, 13,* 1-6. https://dx.doi.org/10.1016/j.tics.2008.09.006

Hume, D. (1969). *A treatise of human nature*. London: Penguin. (Original work published in 1739–1740).

Hutcherson, C. A., & Gross, J. J. (2011). The moral emotions: A social-functionalist account of anger, disgust, and contempt. *Journal of Personality and Social Psychology, 100,* 719-737. https://dx.doi.org/10.1037/a0022408

Inbar, Y., & Pizarro, D. A. (2014). Pollution and purity in moral and political judgment. In J. C. Wright & H. Sarkissian (Eds.), *Advances in Experimental Moral Psychology: Affect, Character, and Commitments* (pp. 111-129). New York: Continuum Press.

Inbar, Y., Pizarro, D. A., & Bloom, P. (2009). Conservatives are more easily disgusted than liberals. *Cognition and Emotion, 23*, 714-725. https://dx.doi.org/10.1080/ 02699930802110007

Inbar, Y., Pizarro, D. A., Iyer, R., & Haidt, J. (2012). Disgust sensitivity, political conservatism, and voting. *Social Psychological and Personality Science, 3,* 537-544. https://dx.doi.org/10.1177/1948550611429024

Inbar, Y., Pizarro, D. A., Knobe, J., & Bloom, P. (2009). Disgust sensitivity predicts intuitive disapproval of gays. *Emotion, 9*, 435-439. https://dx.doi.org/10.1037/a0015960

Iyer, R., Koleva, S., Graham, J., Ditto, P., & Haidt, J. (2012). Understanding libertarian morality: The psychological dispositions of self-identified libertarians. *PloS One, 7*, e42366. https://dx.doi.org/10.1371/journal.pone.0042366

Janoff-Bulman, R., & Sheikh, S. (2011). Unintended consequences of moral "over-regulation". *Emotion Review, 3,* 325-327. https://dx.doi.org/10.1177/1754073911402379

References

Jarudi, I. N. (2009). *Everyday morality and the status quo: Conservative concerns about moral purity, moral evaluations of everyday objects, and moral objections to performance enhancement.* (Doctoral dissertation, Yale University).

Johnson, D. J., Wortman, J., Cheung, F., Hein, M., Lucas, R. E., Donnellan, M. B., . . . Narr, R. K. (2016). The effects of disgust on moral judgments: Testing moderators. *Social Psychological and Personality Science, 7,* 640-647. https://dx.doi.org/10.1177/ 1948550616654211

Jones, A., & Fitness, J. (2008). Moral hypervigilance: The influence of disgust sensitivity in the moral domain. *Emotion, 8,* 613-627. https://dx.doi.org/10.1037/a001345

Kant, I. (1998). *Groundwork of the metaphysics of morals* (M. Gregor, Trans.) Cambridge, U.K.: Cambridge University Press. (Original work published in 1797)

Kayyal, M. H., Pochedly, J., McCarthy, A., & Russell, J. A. (2015). On the limits of the relation of disgust to judgments of immorality. *Frontiers in Psychology, 6*: 951. https://dx.doi.org/10.3389/fpsyg.2015.00951

Keltner, D., & Gross, J. J. (1999). Functional account of emotions. *Cognition and Emotion, 13,* 467-480. https://dx.doi.org/10. 1080/026999399379140

Kemper, N. S., & Newheiser, A. (in press). To confront or to avoid: How do people respond to violations of moral norms? *Social Psychological and Personality Science.* https://dx.doi.org/10. 1177/1948550617722831

Kohlberg, L. (1971). From is to ought: How to commit the naturalistic fallacy and get away with it in the study of moral development. In T. Mischel (Ed.), *Psychology and Genetic Epistemology* (pp. 151-235). New York: Academic Press.

Koleva, S., Graham, J., Haidt, J., Iyer, R., & Ditto, P. H. (2012). Tracing the threads: How five moral concerns (especially Purity) help explain culture war attitudes. *Journal of Research in Personality, 46,* 184-194. https://dx.doi.org/10.1016/j.jrp.2012.01.006

Koleva, S., & Haidt, J. (2012). Let's use Einstein's safety razor, not Occam's swiss army knife or Occam's chainsaw. *Psychological Inquiry, 23,* 175-178. https://dx.doi.org/10.1080/1047840X.2012.667678

Krosnick, J. A., Boninger, D. S., Chuang, Y. C., Berent, M. K., & Carnot, C. G. (1993). Attitude strength: One construct or many related constructs? *Journal of Personality and Social Psychology, 65,* 1132-1151. https://dx.doi.org/10.1037/0022-3514.65.6.1132

Kupfer, T. R., & Giner-Sorolla, R. (2017). Communicating moral motives: The social signaling function of disgust. *Social Psychological and Personality Science, 8,* 632-640. https://dx.doi.org/10.1177/1948550616679236

Kuznetsova A., Brockhoff P. B., & Christensen, R. H. B. (2013). lmerTest: Tests in linear mixed effects models (Version 2.0-11) [Computer software]. Retrieved from https://cran.r-project.org/web/packages/lmerTest/

Laakasuo, M., Sundvall, J., & Drosinou, M. (2017). Individual differences in moral disgust do not predict utilitarian judgments, sexual and pathogen disgust do. *Scientific Reports, 7,* 1-10. http://dx.doi.org/10.1038/srep45526

Landy, J. F., & Goodwin, G. P. (2015). Does incidental disgust amplify moral disgust? A meta analytic review of experimental evidence. *Perspectives on Psychological Science, 10,* 518-536. https://dx.doi.org/10.1177/1745691615583128

References

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2008). International affective picture system (IAPS): Affective ratings of pictures and instruction manual. Technical Report A-8. University of Florida, Gainesville, FL.

Mackie, J. L. (1982). Morality and the retributive emotions. *Criminal Justice Ethics, 1,* 3-10. https://dx.doi.org/10.1080/0731129X.1982.9991689

MacLeod, C., & Mathews, A. (1988). Anxiety and the allocation of attention to threat. *Quarterly Journal of Experimental Psychology, 40,* 653-670. https://dx.doi.org/10.1080/14640748808402292

Markus, K. A., & Borsboom, D. (2013). *Frontiers of test validity theory: Measurement, causation, and meaning*. New York: Routledge. https://dx.doi.org/10.1111/jedm.12055

Mason, E. C., & Richardson, R. (2012). Treating disgust in anxiety disorders. *Clinical Psychology: Science and Practice, 19,* 180-194. https://dx.doi.org/10.1111/j.1468-2850.2012.01282.x

Mataix-Cols, D., An, S. K., Lawrence, N. S., Caseras, X., Speckens, A., Giampetro, V., … Phillips, M. L. (2008). Individual differences in disgust sensitivity modulate neural responses to aversive/disgusting stimuli. *European Journal of Neuroscience, 27*, 3050–3058. https://dx.doi.org/10.1111/j.1460-9568.2008.06311.x

Matchett, G., & Davey, G. C. L. (1991). A test of a disease-avoidance model of animal phobias. *Behaviour Research and Therapy, 29,* 91–94. https://dx.doi.org/10.1016/S0005-7967(09)80011-9

Matthews, A., & MacLeod, C. (2002). Induced processing biases have causal effects on anxiety. *Cognition and Emotion, 16,* 331-354. https://dx.doi.org/10.1080/02699930143000518

McKay, D. (2006). Treating disgust reactions in contamination-based obsessive-compulsive disorder. *Journal of Behavioral Therapy and Experimental Psychology, 37,* 53-59. https://dx.doi.org/10.1016/j.jbtep.2005.09.005

McKay, D. (2017). Presidential address: Embracing the repulsive: The case for disgust as a functionally central emotional state in the theory, practice, and dissemination of cognitive-behavior therapy. *Behavior Therapy, 48,* 731-738. https://dx.doi.org/10.1016/ j.beth.2017.08.006

Mendez, M. F., Anderson, E., & Shapira, J. S. (2005). An investigation of moral judgement in frontotemporal dementia. *Cognitive and Behavioral Neurology, 18,* 193-197. https://dx.doi.org/ 10.1097/01.wn.0000191292.17964.bb

Molho, C., Tybur, J. M., Güler, E., Balliet, D., & Hofmann, W. (2017). Disgust and Anger Relate to Different Aggressive Responses to Moral Violations. *Psychological Science, 28*, 609-619. https://dx.doi.org/10.1177/0956797617692000

Mogg, K., & Bradley, B. P. (2002). Selective orienting of attention to masked threat faces in social anxiety. *Behaviour Research and Therapy*, *40*, 1403–1414. https://dx.doi.org/ 10.1016/S0005-7967(02)00017-7

Mogg, K., Millar, N., & Bradley, B. P. (2000). Biases in eye movements to threatening facial expressions in generalized anxiety disorder and depressive disorder. *Journal of Abnormal Psychology, 109,* 695-704. https://dx.doi.org/10.1037/0021-843X.109.4.695

Mogg, K., Philippot, P., & Bradley, B. P. (2004). Selective attention to angry faces in clinical social phobia. *Journal of Abnormal Psychology, 113,* 160-165. https://dx.doi.org/ 10.1037/0021-843X.113.1.160

References

Moll, J., de Oliveira-Souza, R., Moll, F. T., Ignácio, F. A., Bramati, I. E., Caparelli-Dáquer, E. M., & Eslinger, P. J. (2005). The moral affiliations of disgust: A functional MRI study. *Cognitive and Behavioral Neurology, 18,* 68-78. https://dx.doi.org/10.1097/ 01.wnn.0000152236.46475.a7

Moretz, M. W., & McKay, D. (2008). Disgust sensitivity as a predictor of obsessive-compulsive contamination symptoms and associated cognitions. *Journal of Anxiety Disorders, 22,* 707-715. https://dx.doi.org/10.1016/j.janxdis.2007.07.004

Morey, R. D., & Rouder, J. N. (2014). BayesFactor 0.9.12-2. Comprehensive R Archive Network. Retrieved from https://cran.r-project.org/web/packages/BayesFactor/index.html

Mortensen, C. R., Becker, D. V., Ackerman, J. M., Neuberg, S. L., & Kenrick, D. T. (2010). Infection breeds reticence: The effects of disease salience on self-perceptions of personality and behavioral avoidance tendencies. *Psychological Science, 21,* 440-447. http://dx.doi.org/10.1177/0956797610361706

Mulkens, S. A. N., De Jong, P. J., & Merckelbach, H. (1996). Disgust and spider phobia. *Journal of Abnormal Psychology, 105,* 464-468. https://dx.doi.org/10.1037/0021-843X.105.3.464

Muris, P., Merckelbach, H., Nederkoorn, S., Rassin, E., Candel, I., & Horselenberg, R. (2000). Disgust and psychopathological symptoms in a nonclinical sample. *Personality and Individual Differences, 29,* 1163-1167. https://dx.doi.org/10.1016/S0191-8869(99)00263-9

Muris, P., Merckelbach, H., Schmidt, H., & Tierney, S. (1999). Disgust sensitivity, trait anxiety and anxiety disorders symptoms in normal children. *Behaviour Research and Therapy, 37,* 953-961. https://dx.doi.org/10.1016/S0005-7967(99)00045-5

Navarrete, C. D., & Fessler, D. M. T. (2006). Disease avoidance and ethnocentrism: The effects of disease fears and disgust sensitivity on intergroup attitudes. *Evolution and Human Behavior, 27*, 270-282. https://dx.doi.org/10.1016/j.evolhumbehav.2005.12.001

Nichols, S. (2004). *Sentimental rules: On the natural foundations of moral judgment.* Oxford: Oxford University Press.

Nucci, L. P. (1986). Children's conceptions of morality, social conventions, and religious prescriptions. In C. Harding (Ed.) *Moral dilemmas: Philosophical and psychological reconsiderations of the development of moral reasoning* (pp. 137-174). Chicago: Precedent Press.

Oaten, M., Stevenson, R. J., & Case, T. I. (2009). Disgust as a disease-avoidance mechanism. *Psychological Bulletin, 135,* 303-321. https://dx.doi.org/10.1037/a0014823

Öhman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: Detecting the snake in the grass. *Journal of Experimental Psychology: General, 130,* 466-478. https://dx.doi.org/10.1037/0096-3445.130.3.466

Okimoto, T. G., & Gromet, D. M. (2016). Differences in sensitivity to deviance partly explain ideological divides in social policy support. *Journal of Personality and Social Psychology, 111*, 98-117. https://dx.doi.org/10.1037/pspp0000080

Olatunji, B. O. (2008). Disgust, scrupulosity and conservative attitudes about sex: Evidence for a mediational model of homophobia. *Journal of Research in Personality, 42*, 1364-1369. https://dx.doi.org/10.1016/j.jrp.2008.04.001

References

Olatunji, B. O., Adams, T., Ciesielski, B., David, B., Sarawgi, S., & Broman-Fulks, J. (2012). The three domains of disgust scale: Factor structure, psychometric properties, and conceptual limitations. *Assessment, 19,* 205-225. https://dx.doi.org/10.1177/1073191111432881

Olatunji, B. O., Haidt, J., McKay, D., & David, B. (2008). Core, animal reminder, and contamination disgust: Three kinds of disgust with distinct personality, behavioral, physiological, and clinical correlates. *Journal of Research in Personality, 42,* 1243-1259. http://dx.doi.org/10.1016/j.jrp.2008.03.009

Olatunji, B. O., Lohr, J. M., Sawchuk, C. N., & Tolin, D. F. (2007). Multimodal assessment of disgust in contamination-related obsessive-compulsive disorder. *Behaviour Research and Therapy, 45,* 263-276. https://dx.doi.org/10.1016/j.brat.2006.03.004

Olatunji, B. O., & McKay, D. (2009). *Disgust and its disorders: Theory, assessment, and treatment implications.* Washington, DC: American Psychological Association. https://dx.doi.org/10.1037/11856-000

Olatunji, B. O., Williams, N. L., Tolin, D. F., Sawchuck, C. N., Abramowitz, J. S., Lohr, J. M., & Elwood, L. (2007). The Disgust Scale: Item analysis, factor structure, and suggestions for refinement. *Psychological Assessment, 19,* 281-197. https://dx.doi.org/10.1037/1040-3590.19.3.281

Olatunji, B. O., Wolitzky-Taylor, K. B., Willems, J., Lohr, J. M., & Armstrong, T. (2009). Differential habituation of fear and disgust during repeated exposure to threat-relevant stimuli in contamination-based OCD: An analogue study. *Journal of Anxiety Disorders, 23,* 118-123. https://dx.doi.org/10.1016/j.janxdis.2008.04.006

Parkinson, C., Sinnott-Armstrong, W., Koralus, P. E., Mendelovici, A., McGeer, V., & Wheatley, T. (2011). Is morality unified? Evidence that distinct neural systems underlie moral judgments of harm, dishonesty, and disgust. *Journal of Cognitive Neuroscience, 23,* 3162-3180. https://dx.doi.org/10.1162/jocgn_a_00017

Park, J. H., Faulkner, J., & Schaller, M. (2003). Evolved disease-avoidance processes and contemporary anti-social behavior: Prejudicial attitudes and avoidance of people with physical disabilities. *Journal of Nonverbal Behavior, 27,* 65- 87. http://dox.doi.org/10.1023/A:1023910408854

Park, J. H., Schaller, M., & Crandall, C. S. (2007). Pathogen-avoidance mechanisms and the stigmatization of obese people. *Evolution and Human Behavior, 28,* 410-414. https://dx.doi.org/10.1016/j.evolhumbehav.2007.05.008

Park, J. H., Van Leeuwen, F., & Stephen, I. D. (2012). Homeliness is in the disgust sensitivity of the beholder: Relatively unattractive faces appear especially unattractive to individuals higher in pathogen disgust. *Evolution and Human Behavior, 33,* 569-577. http://doi.org/10.1016/j.evolhumbehav.2012.02.005

Pettigrew, T. F., & Tropp, L. R. (2006). A meta-analytic test of intergroup contact theory. *Journal of Personality and Social Psychology, 90,* 751-783. https://dx.doi.org/10.1037/0022-3514.90.5.751

Plato (2008). *The Republic* (B. Jowett, Trans.) Retrieved from https://www.gutenberg.org/files/1497/1497-h/1497-h.htm#link2H_4_0007 (Original work published ca. 360 BC).

References

Piazza, J., Landy, J. F., Chakroff, A., Young, L., & Wasserman, E. (in press). What disgust does and does not do for moral cognition. In N. Strohminger & V. Kumar (Eds.) *The moral psychology of disgust*. London: Rowman & Littlefield.

Pivetti, M. (2007). Natural and unnatural: Activists' representations of animal biotechnology. *New Genetics and Society, 26,* 137-257. https://dx.doi.org/10.1080/14636770701466840

Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research, 42*, 185-227. https://dx.doi.org/10.1080/00273170701341316

Prinz, J. (2006). The emotional basis of moral judgments. *Philosophical Explorations, 9,* 29-43. https://dx.doi.org/10.1080/13869790500492466

R Core Team (2017). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

Richards, A., & Blanchette, I. (2004). Independent manipulation of emotion in an emotional Stroop Task using classical conditioning. *Emotion, 4,* 275-281. https://dx.doi.org/10.1037/1528-3542.4.3.275

Richerson, P. J., & Boyd, R. (2005). *Not by genes alone: How culture transformed the evolutionary process*. Chicago: University of Chicago Press.

Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*, 1-36. https://dx.doi.org/10.18637/jss.v048.i02

Rottman, J., DeJesus, J. M., & Gerdin, E. (in press). The social origins of disgust. In N. Strohminger & V. Kumar (Eds.) *The moral psychology of disgust*. London: Rowman & Littlefield.

Royzman, E., Atanasov, P., Landy, J. F., Parks, A., & Gepty, A. (2014). CAD or MAD? Anger (not disgust) as the predominant response to pathogen-free violations of the divinity code. *Emotion, 14,* 892-907. https://dx.doi.org/10.1037/ a0036829

Royzman, E. B., & Sabini, J. (2001). Something it takes to be an emotion: The interesting case of disgust. *Journal for the Theory of Social Behaviour, 31,* 29-59. https://dx.doi.org/10. 1111/1468-5914.00145

Rozin, P., & Fallon, A. E. (1987). A perspective on disgust. *Psychological Review, 94,* 23-41. https://dx.doi.org/10.1037/ 0033-295X.94.1.23

Rozin, P., Haidt, J., & McCauley, C. R. (2000). Disgust. In M. Lewis & J. M. Haviland-Jones (Eds.), *Handbook of emotions*, *2nd Edition* (pp. 637-653). New York: Guilford Press.

Rozin, P., Haidt, J., McCauley, C. R., Dunlop, L., & Ashmore, M. (1999). Individual differences in disgust sensitivity: Comparisons and evaluations of paper-and-pencil versus behavioral measures. *Journal of Research in Personality, 33*, 330-351. https://dx.doi.org/10.1006/ jrpe.1999.2251

Rozin, P., Lowery, L., & Ebert, R. (1994). Varieties of disgust faces and the structure of disgust. *Journal of Personality and Social Psychology, 66,* 870-881. https://dx.doi.org/10.1037/ 0022-3514.66.5.870

Rozin, P., Lowery, L., Imada, S., & Haidt, J. (1999). The CAD triad hypothesis: A mapping between three moral emotions (contempt, anger, disgust) and three moral codes (community, autonomy, divinity). *Journal of Personality and Social Psychology, 76*, 574-586. https://dx.doi.org/10.1037/ 0022-3514.76.4.574

References

Rozin, P., Millman, L., & Nemeroff, C. (1986). Operation of the laws of sympathetic magic in disgust and other domains. *Journal of Personality and Social Psychology, 50,* 703-712. http://dx.doi.org/10.1037/0022-3514.50.4.703

Russell, P. S., & Giner-Sorolla, R. (2013). Bodily moral disgust: What it is, how it is different from anger, and why it is an unreasoned emotion. *Psychological Bulletin, 139,* 328-351. https://dx.doi.org/10.1037/a0029319

Sabo, J. S., & Giner-Sorolla, R. (2017). Imagining wrong: Fictitious contexts mitigate condemnation of harm more than impurity. *Journal of Experimental Psychology: General, 146*, 134-153. https://dx.doi.org/10.1037/xge0000251

Salemink, E., Van den Hout, M. A., & Kindt, M. (2007). Selective attention and threat: Quick orienting versus slow disengagement and two versions of the dot probe task. *Behaviour Research and Therapy, 45,* 607-615. https://dx.doi.org/10.1016/j.brat.2006.04.004

Sato, A., & Sugiura, Y. (2014). Dispositional mindfulness modulates automatic transference of disgust into moral judgment. *Japanese Journal of Psychology, 84,* 605–611. https://dx.doi.org/10.4992/jjpsy.84.605

Schein, C., & Gray, K. (2015). The unifying moral dyad: Liberals and conservatives share the same harm-based moral template. *Personality and Social Psychology Bulletin, 41,* 1147-1163. https://dx.doi.org/10.1177/0146167215591501

Schein, C., & Gray, K. (in press). The theory of dyadic morality: Reinventing moral judgment by redefining harm. *Personality and Social Psychology Review*. https://dx.doi.org/10.1177/1088868317698288

Schein, C., Ritter, R. S., & Gray, K. (2016). Harm mediates the disgust-immorality link. *Emotion, 16,* 862-876. https://dx.doi.org/10.1037/emo0000167

Schönbrodt, F. D., & Perugini, M. (2013). At what sample size do correlations stabilize? *Journal of Research in Personality, 47,* 609-612. https://dx.doi.org/10.1016/j.jrp.2013.05.009

Schnall, S., Benton, J., & Harvey, S. (2008). With a clean conscience: Cleanliness reduces the severity of moral judgments. *Psychological Science, 19,* 1219–1222. https://dx.doi.org/10.1111/j.1467-9280.2008.02227.x

Schnall, S., Haidt, J., Clore, G. L., & Jordan, A. H. (2008). Disgust as embodied moral judgment. *Personality and Social Psychology Bulletin, 34,* 1096–1109. https://dx.doi.org/10.1177/0146167208317771

Schwarz, N., & Clore, G. L. (1983). Mood, misattribution and judgments of well-being: Informative and directive functions of affective states. *Journal of Personality and Social Psychology, 45,* 513-523. https://dx.doi.org/10.1037/0022-3514.45.3.513

Sears, C. R., Thomas, C. L., LeHuquet, J. M., & Johson, J. C. S. (2010). Attentional biases in dysphoria: An eye-tracking study of the allocation and disengagement of attention. *Cognition and Emotion, 24,* 1349-1368. https://dx.doi.org/10.1080/02699930903399319

Seidel, A., & Prinz, J. (2013). Sound morality: Irritating and icky noises amplify judgments in divergent moral domains. *Cognition, 127,* 1–5. https://dx.doi.org/10.1016/j.cognition.2012.11.004

References

Shweder, R. A., Much, N. C., Mahapatra, M., & Park, L. (1997). The "Big Three" of morality (autonomy, community, divinity) and the "Big Three" explanations of suffering. In A. Brandt & P. Rozin (Eds.), *Morality and health* (pp. 119-169). New York: Routledge

Shook, N. J., Oosterhoff, B., Terrizzi, J. A., Jr., & Brady, K. M. (2017). “Dirty politics”: The role of disgust sensitivity in voting. *Translational issues in Psychological Science, 3*, 284-297. https://dx.doi.org/10.1037/tps0000111

Simpson, J., Carter, S., Anthony, S. H., & Overton, P. G. (2006). Is disgust a homogeneous emotion? *Motivation and Emotion, 30,* 31-41. https://dx.doi.org/10.1007/s11031-006-9005-1

Skitka, L. J., Bauman, C. W., & Sargis, E. G. (2005). Moral conviction: Another contributor to attitude strength or something more? *Journal of Personality and Social Psychology, 88,* 895-917. https://dx.doi/org/10.1037/0022-3514.88.6.895

Smith, K. B., Oxley, D., Hibbing, M. V., Alford, J. R., & Hibbing, J. R. (2011). Disgust sensitivity and the neurophysiology of left–right political orientations. *PloS One, 6*, e25552. https://dx.doi.org/10.1371/journal.pone.0025552

Spielberger, C. D. (1999). *State-Trait Anger Expression Inventory—Revised*. Odessa, FL: Psychological Assessment Resources. https://dx.doi.org/10.1002/9780470479216. corpsy0942

Tannenbaum, D., Uhlmann, E. L., & Diermeier, D. (2011). Moral signals, public outrage, and immaterial harms. *Journal of Experimental Social Psychology*, *47*, 1249-1254. https://dx.doi.org/10.1016/j.jesp.2011.05.010

Tenbült, P., De Vries, N. K., Dreezens, E., & Martijn, C. (2005). Perceived naturalness and acceptance of genetically modified food. *Appetite, 45,* 47-50. https://dx.doi.org/10.1016/j.appet.2005.03.004

Terrizzi, J. A., Shook, N. J., & Ventis, L. (2010). Disgust: A predictor of social conservatism and prejudicial attitudes toward homosexuals. *Personality and Individual Differences, 49,* 587–592. https://dx.doi.org/10.1016/j.evolhumbehav.2012.10.003

Thomson, J. J. (1976). Killing, letting die, and the trolley problem. *The Monist, 59,* 204-217. https://dx.doi.org/10.5840/monist197659224

Thomson, J. J. (1985). The trolley problem. *The Yale Law Journal, 94,* 1395-1415. https://dx.doi.org/10.2307/796133

Tolin, D. F., Lohr, J. M., Sawchuk, C. N., & Lee, T. C. (1997). Disgust and disgust sensitivity in blood-injection-injury and spider phobia. *Behaviour Research and Therapy, 35,* 949-953. https://dx.doi.org/10.1016/S0005-7967(97)00048-X

Tolin, D. F., Woods, C. M., & Abramowitz, J. S. (2005). Disgust sensitivity and obsessive-compulsive symptoms in a non-clinical sample. *Journal of Behavior Therapy and Experimental Psychiatry, 37,* 30-40. https://dx.doi.org/10.1016/j.jbtep.2005.09.003

Turiel, E. (2008). Thought about actions in social domains: Morality, social conventions, and social interactions. *Cognitive Development, 23,* 136-154. https://dx.doi.org/10.1016/j.cogdev.2007.04.001

Tybur, J. M., & De Vries, R. E. (2013). Disgust sensitivity and the HEXACO model of Personality. *Personality and Individual Differences, 55*, 660-665. https://dx.doi.org/10.1016/j.paid.2013.05.008

References

Tybur, J. M., Inbar, Y., Aarøe, L., Barclay, P., Barlow, F. K., De Barra, M., … Žezelj, I. (2016). Parasite stress and pathogen avoidance relate to distinct dimensions of political ideology across 30 nations. *Proceedings of the National Academy of Sciences, 113,* 12408-12413. https://dx.doi.org/10.1073/pnas.1607398113

Tybur, J. M., Lieberman, D. L., & Griskevicius, V. G. (2009). Microbes, mating, and morality: Individual differences in three functional domains of disgust. *Journal of Personality and Social Psychology, 29,* 103-122. https://dx.doi.org/10.1037/a0015474

Tybur, J. M., Lieberman, D., Kurzban, R., & DeScioli, P. (2013). Disgust: Evolved function and structure. *Psychological Review, 120*, 65-84. https://dx.doi.org/10.1037/a0030778

Tybur, J. M., Merriman, L. A., Caldwell Hooper, A. E., McDonald, M. M. & Navarrete, C. D. (2010). Extending the behavioral immune system to political psychology: Are political conservatism and disgust sensitivity really related? *Evolutionary Psychology 8,* 599–616. http://dx.doi.org/10.1177/147470491000800406

Ugazio, G., Lamm, C., & Singer, T. (2012). The role of emotions for moral judgments depends on the type of emotion and moral scenario. *Emotion, 12*, 579-590. https://dx.doi.org/10.1037/a0024611

Uhlmann, E. L., & Zhu, L. (2013). Acts, persons, and intuitions: Person-centered cues and gut reactions to harmless transgressions. *Social Psychological and Personality Science, 5,* 279-285. https://dx.doi.org/10.1177/1948550613497238

Van Dillen, L. F., & Vanderveen, G. (2017). Gruwelijke beelden van plaatsen delict: Kijkstrategieën, opgewekte emoties en oordeelsvorming. *Tijdschrift voor Criminologie, 59,* 176-193. https://dx.doi.org/10.5553/TvC/0165182X2017059102010

Van Dillen, L. F., van der Wal, R. C., & van den Bos, K. (2012). On the role of attention and emotion in morality: Attentional control modulates unrelated disgust in moral judgments. *Personality and Social Psychology Bulletin, 38,* 1222–1231. https://doi.org/10.1177%2F0146167212448485

Van Leeuwen, F., Dukes, A., Tybur, J. M., & Park, J. H. (2017). Disgust sensitivity relates to moral foundations independent of political ideology. *Evolutionary Behavioral Sciences, 11,* 92-98. https://dx.doi.org/10.1037/ebs0000075

Van Overveld, M., De Jong, P. J., & Peters, M. L. (2010). The Disgust Propensity and Sensitivity Scale – Revised: Its predictive value for avoidance behavior. *Personality and Individual Differences, 49,* 706-711. https://dx.doi.org/10.1016/j.paid.2010.06.008

Van Overveld, W. J. M., de Jong, P. J., Peters, M. L., Cavanagh, K., & Davey, G. C. L. (2006). Disgust propensity and disgust sensitivity: Separate constructs that are differentially related to specific fears. *Personality and Individual Differences, 41*, 1241-1252. https://dx.doi.org/10.1016/j.paid.2006.04.021

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, *36*, 1-48. https://dx.doi.org/10.18637/jss.v036.i03

Visser, P. S., Bizer, G. Y., & Krosnick, J. A. (2006). Exploring the latent structure of strength related attitude attributes. In M. Zanna (Ed.), *Advances in Experimental Social Psychology, Vol. 38* (pp. 1-67). New York, NY: Academic Press.

References

Von der Marlsburg (2015). Saccades: Detection of fixations in eye-tracking data. R package version 0.1-1. https://CRAN.R-project.org/package=saccades

Vrana, S. R. (1993). The psychophysiology of disgust: Differentiating negative emotional contexts with facial EMG. *Psychophysiology, 30,* 279-286. https://dx.doi.org/10.1111/j.1469-8986.1993.tb03354.x

Wagemans, F. M. A., Brandt, M. J., & Zeelenberg, M. (2017). Disgust sensitivity and moral judgments of purity: The role of transgression weirdness. Retrieved from https://psyarxiv.com/c5h42

Wagemans, F. M. A., Brandt, M. J., & Zeelenberg, M. (2018). Disgust sensitivity is primarily associated with purity-based moral judgments. *Emotion 18,* 277-289. https://dx.doi.org/10.1037/emo0000359

Wagemans, F. M. A., Brandt, M. J., & Zeelenberg, M. (in preparation). A laymen's perspective on disgust.

Wang, X., Yang, L., Yang, J., Wang, P., & Lei, L. (2017). Trait anger and cyberbullying among young adults: A moderated mediation model of moral disengagement and moral identity. *Computers in Human Behavior, 73,* 519-526. https://dx.doi.org/10.1016/j.chb.2017.03.073

Watts, F. N., McKenna, F. P., Sharrock, R., & Trezise, L. (1986). Colour naming of phobia-related words. *British Journal of Psychology, 77,* 97-108. https://dx.doi.org/10.1111/j. 2044-8295.1986.tb01985.X

Wheatley, T., & Haidt, J. (2005). Hypnotic disgust makes moral judgments more severe. *Psychological Science, 16,* 780-784. https://dx.doi.org/10.1111/j.1467-9280.2005.01614.x

Wittmann, M., Arce, E., & Santisteban, C. (2008). How impulsiveness, trait anger, and extracurricular activities might affect aggression in school children. *Personality and Individual Differences, 45,* 618-623. https://dx.doi.org/10.1016/j.paid.2008.07.001

Woody, S. R., McLean, C., & Klassen, T. (2005). Disgust as a motivator of avoidance of spiders. *Anxiety Disorders, 19,* 461-475. https://dx.doi.org/10.1016/j.janxdis.2004.04.002

Woody, S. R., & Tolin, D. F. (2002). The relationship between disgust sensitivity and avoidant behavior: Studies of clinical and nonclinical samples. *Journal of Anxiety Disorders, 16,* 543-559. https://dx.doi.org/10.1016/S0887-6185(02)00173-1

Young, L., & Saxe, R. (2011). When ignorance is no excuse: Different roles for intent across moral domains. *Cognition, 120,* 202-214. https://dx.doi.org/10.1016/ j.cognition.2011.04.005

Zeelenberg, M., & Pieters, R. (2006). Feeling is for doing: A pragmatic approach to the study of emotions in economic behavior. In D. DeCremer, M. Zeelenberg & J. K. Murnighan (Eds.), *Social psychology and economics* (pp. 117–137). Mahwah, NJ: Erlbaum.

Zhang, Z., Zyphur, M. J., & Preacher, K. J. (2009). Testing multilevel mediation using hierarchical linear models: Problems and solutions. *Organizational Research Methods*, *12*, 695-719. https://dx.doi.org/10.1177/1094428108327450

Acknowledgements

This thesis would not have reached the light of day without the help and support of many great people. Here, I would like to take a moment to thank them.

First of all, I want to thank my supervisors.

Mark. You are not only successful and exceptionally modest, you are also a great supervisor. I want to thank you for your encouragement to seek and try out new opportunities; your incredibly fast feedback on my drafts; your “jokes” about my Limburgian origin (I know they are borne out of jealousy); your unlimited patience for my questions about statistical analyses; your advice to celebrate any review that is not a rejection; and your usage of GIFs instead of words in response to emails. I have learned a lot from you and (disregarding the fact that you’re a cat person) I couldn't have wished for a better supervisor.

Marcel. Onze samenwerking begon toen ik in de Research Master zat en jij dacht dat ik permanent boos op je was. Nu, jaren later, ben je gelukkig gewend aan mijn ‘resting bitch face’ en heb ik veel geleerd van je inzichten en adviezen. Mijn PhD project verliep niet altijd soepeltjes, wat voor flink wat stress zorgde, maar jij overtuigde me er altijd van dat het allemaal wel goed zou komen. Daar ben ik je heel dankbaar voor. Daarnaast leek het je persoonlijke doel om ervoor te zorgen dat onze wekelijkse afspraken nooit saai waren. Je walgelijke anecdotes werden misschien niet altijd genoeg gewaardeerd door mij, maar alleen dit soort verhalen kunnen leiden tot legendarische scenario’s over op tapijt plassende inbrekers.

Mark and Marcel, I feel incredibly privileged that I got the chance to work with you. I hope we will continue our collaboration and keep having drinks together in the future. Thank you for everything.

I would also like to thank all my colleagues in the Social Psychology department. You made my four years as a PhD student great in so many ways, whether it was by giving critical feedback in lab meetings, organizing or joining (mini) department outings, drinking coffee together, drinking beer together, starting weird (but entertaining) lunch conversations, having candy up for grabs in your office, shooting NERF guns in the office, collaborating with me, stopping by for random chitchat, covering my office in balloons and puppy pictures, giving advice, or shouting “coffeeeeeee” through the hallway. You are the reason this department is an amazing place to work and I will miss all of you.

Special thanks goes to my three paranimphs: Bastian, Willem, and Paulette. I am proud to have you three standing behind me during my defense and I am happy to share this special day with you.

Bastian, it is difficult to describe in words what I feel for you. I know I am an incredibly lucky girl to have found a guy like you, who not only gives me his unconditional love and support, but who also embraces my inner weirdo. I look forward to all the exciting adventures that are awaiting us. You make me very happy. I love you.

Will, my PhD wouldn’t have been the same without you. For one, my syntax would have looked a lot messier. When we started sharing an office, I thought you were weird. Four years later, I still think you’re weird. I also still don’t get most of your references, but I know now that you’re cool – cool, cool, cool.

Lettie, ik bof met de grappige, geweldige en enorm liefdevolle vriendin die jij bent. Onze avondjes gevuld met geklets, gelach, soms een traantje, wijn en kaas waren vaak precies wat ik nodig had. Of het leven me nou toelacht of het allemaal even tegenzit, ik weet dat jij er voor mij bent met een luisterend oor. Er is niemand met wie ik zo graag een ~~glas~~ fles wijn drink als met jou.

Byron, Chrissie, Flo, Gaby, Lis, Maaike, Mich, Michael, Nina, Paul, Tine, and Tünde. Moving to Tilburg turned out to be a great decision because you welcomed me into your group with open arms (and lots of cheese, prosecco, wine, and cocktails). I love our game

nights, brunches, Halloween events, girls' nights, weekends away, and random get-togethers. There are few people who understand the ups and downs of PhD life better than you do. Thanks for being this awesome.

Keri, Minou en Suzanne. Mijn ReMa-maatjes. Mijn vriendinnetjes door dik en dun. Als wij vieren samen zijn is het leven goed. Stiltes zijn dan schaars, schaterlachen gebeurt in overvloed en er is simpelweg even geen tijd om te stressen over werk. Met vriendinnen zoals jullie is het altijd genieten met de pet op. Bedankt voor jullie liefde, steun en begrip.

Al mijn vrienden in Horst, bedankt voor de leuke avondjes uit en gezellige weekendjes weg. Jullie zorgden ervoor dat ik zo nu en dan even helemaal uit het academische en stadse wereldje en in het vertrouwde dorpse wereldje kon stappen.

Ich möchte mich auch noch bei meiner deutschen Familie bedanken, die mich mit offenen Armen aufgenommen hat. Besonders Heike und Frank; danke für die entspannten Wochenenden in Mülheim, die vielen, leckeren Stücke Kuchen und dafür, dass ihr immer so tut als wär mein lausiges Deutsch perfekt.

Bono (Boën). Zelf heb je waarschijnlijk niet door hoe belangrijk je bent. Je hebt enorm grote oren en daarmee kan jij als geen ander onbevooroordeeld naar mijn sores luisteren. Samen wandelen in de bossen of even lekker knoevele, in no-time smoor jij elke vorm van stress in de kiem.

Lea. Het is bijna 25 jaar geleden dat je oppas werd in huize Wagemans en er iedere dag drie dreumels aan je benen hingen als je naar huis ging. Nu hang ik niet meer aan je benen als je naar huis gaat, maar je bent inmiddels wel een erg speciale aanvulling op onze familie geworden.

Oma. Bedankt voor alle fijne koffie-uurtjes en voor de állerlekkerste appeltaart ter wereld.

Bram en Fennie. Zoals dat hoort bij broers en zussen konden we niet altijd even goed met elkaar overweg. Ik ben blij dat we nu

wel samen biertjes (en shotjes) kunnen drinken, spelletjes kunnen spelen en zelfs een backpackvakantie samen overleven.

Pap en mam. Bedankt dat jullie er altijd voor mij zijn en voor alle kansen die jullie mij geboden hebben. Ik had dit niet bereikt zonder jullie en ben dankbaar voor jullie onvoorwaardelijke steun, zelfs als jullie eigenlijk van mening zijn dat ik te veel hooi op mijn vork heb genomen.